

Atlantic Richfield Company

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September 4, 2015

Mr. Steven Way
On-Scene Coordinator
Emergency Response Program (8EPR-SA)
US EPA Region 8
1595 Wynkoop Street
Denver, CO 80202-1129

Delivered via e-mail

Subject: August 2015 Monthly Progress Report
Rico-Argentine Mine Site – Rico Tunnels
Operable Unit OU01, Rico, Colorado

Dear Mr. Way,

This progress report describes activities conducted during the month of August 2015 at the Rico-Argentine Mine Site (site) and activities anticipated to occur during the upcoming month. These activities are organized by task as identified in the Removal Action Work Plan. This progress report is being submitted in accordance with Paragraph 35.a of the Unilateral Administrative Order for Removal Action (the “UAO”), dated March 17, 2011 (effective March 23, 2011).

Under separate cover, an updated project schedule will be submitted to EPA that reflects approval to defer completion of certain work activities to the 2016 construction season. A meeting with EPA will be scheduled in mid-to late October following hydraulic commissioning of the Enhanced Wetland Demonstration system to discuss the UAO schedule modifications.

ACTIVITIES FOR AUGUST

This section describes significant developments during the preceding period including actions performed and any problems encountered during this reporting period. A summary of the St. Louis Tunnel Discharge Constructed Wetland Demonstration (Wetland Demonstration) Treatability Study system performance is provided as Attachment 1 (including key performance indicator figures, tables, and a wetland plant update). A Performance Summary Technical Memorandum, Period of September 15, 2014 through July 15, 2015, St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study (dated August 21, 2015) is provided as Attachment 2.

Site-Wide Activities

- Monitored site for any major security concerns and system functionality.
- Continued work with the US Forest Service (USFS) in support of the Small Tracts Act (STA) acquisition of parcels in the North St. Louis Ponds area (STA 1). Met with USFS San Juan Land and Mineral Manager, USFS Land Appraiser, and the appraiser completing the Rico STA 1 work on August 12, 2015 in Rico, Colorado. The appraisers toured the site and the three STA 1 properties. In addition to STA 1, USFS officials have informed Atlantic Richfield Company (AR)

that USFS lands underlying portions of Ponds 12, 13, and 14 should be eligible for transfer under the STA regulations. AR will be preparing a second STA (STA-2) application for these lands.

- Continued to coordinate with the Rico Town Manager regarding the Town's water pipeline replacement project progress and plans for soil removal, sampling, and disposal at the Soil Lead Repository.
- Continued borrow soil investigation with material gradation and volumetric determinations of potential borrow sources on and near the site.
- Continued to work on acquisition of local borrow soil locations.

Task A – Pre-Design and Ongoing Site Monitoring

- Performed additional evaluation of potential improvements to surface water flow data gathering and telemetry.
- Collected data from pressure transducers at DR-3, DR-6, and AT-2. Collected manual flow measurements from DR-3 and DR-6.
- Added pressure transducer at AT-2 to the site telemetry system.
- Inspected the St. Louis Ponds System, pond water levels, free-board, and condition of outlet pipes and overflow spillways. The pond network appears to be flowing well and in good condition.

Task B – Management of Precipitation Solids in the Upper Settling Ponds

- Diverted the majority of St. Louis Adit discharge to Pond 12. A slip stream flow continues to be diverted to the Wetland Demonstration vertical and horizontal treatment trains prior to being routed to Pond 12.
 - Slip stream to the wetlands was turned off temporarily from August 4, 2015 to August 7, 2015 for piping connections.
 - Diverted St. Louis Adit discharge to Pond 18 on August 10, 2015 for approximately one hour to perform piping connections.
- Continued planning for removal of remaining mining/mineral processing by-products from Upper Ponds.
- Completed solids removal from Pond 14 and hauling excavated material to Pond 13 on August 26, 2015.

Task C – Design and Construction of a Solids Repository

- Construction of the Solids Repository is substantially complete.
- Continued work for interim management of mining/mineral processing by-products.
- Continued work on the Solids Repository Construction Completion Report (which will include as-built drawings and documentation of quality control and quality assurance testing).

Task D – Hydraulic Control Measures for the Collapsed Area of St. Louis Tunnel Adit

- AR incorrectly stated in the July 2015 Monthly Progress Report that construction activities relating to Stage 2 Adit Hydraulic Controls were being deferred until 2016.
- Continued monitoring of AT-2 and BAH-01 to assess water levels in the tunnel at approximately 30 ft and 60 ft in-by of the point at which flows daylight in the SLT channel.
- Initiated design of pressure transducer installation in BAH-01 and borehole spatial survey of both AT-2 and BAH-01.
- Completed initial estimates of volume of water impounded within the SLT tunnel system.
- Initiated design of a passive tunnel dewatering system to be implemented this fall via AT-2 to mitigate rising head levels within the tunnel.
- Initiated planning and design of a series of tunnel drawdown and recovery tests to evaluate the volume and rate of excess flows into the tunnel resulting in rising head levels versus SLT flows exiting the tunnel.



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- Initiated planning for design of a pressure relief well system to be installed in 2016 to address future head levels versus SLT flows based on recent data. Recent data indicates some reduction in hydraulic permeability associated with the tunnel debris is occurring

Task E – Source Water Investigations and Controls

- Continued Blaine Tunnel water depth and flow monitoring behind the Blaine Coffer Dam at the Blaine Tunnel Flume.

Task F – Water Treatment System Analysis and Design

- Conducted floc testing of St. Louis Adit discharge water.
- Completed H₂S monitoring throughout the month and calibrated H₂S monitors.
- Added additional water quality Sonde at Aeration Channel Inflow to compare with water quality collected at Horizontal Sub-Surface Flow Wetland Monitoring Port 11.
- Maintenance and process adjustments conducted on the Wetland Demonstration for performance improvement.
- Shut off flow to the wetland from August 4, 2015 to August 7, 2015 for discharge piping connections.
- Continued Enhanced Wetland Demonstration (EWD) construction.
 - Continued backfilling excavated areas of Pond 18 with bridging material excavated from on-site.
 - Completed backfilling Pond 14 with bridging material excavated from on-site.
 - Placed geo-grid above bridge material as needed throughout Pond 18.
 - Placed structural fill for construction of wetland cells at Pond 18.
 - Completed final grading of the biotreatment cell and commenced liner installation.
 - Began welding HDPE pipe and installing piping between the wetland cells.
 - Began shaping and grading storm water drainage swales and installed culverts around the EWD footprint.
 - Continued procurement of equipment and materials.

ACTIVITIES FOR UPCOMING MONTH

This section describes developments expected to occur during the upcoming reporting period, including a schedule of work to be performed, anticipated problems, and planned resolution of past or anticipated problems.

Site-Wide Activities

- Perform ongoing security observation of the site.
- Continue water flow management for St. Louis Adit discharge to accommodate new construction.
- Continue borrow soil investigation and potential site acquisition.
- Work with USFS to complete STA 1 transfers to AR and submit STA 2 application to the USFS.
- Coordinate with Town of Rico to sample and receive mining impacted soils from pipeline installation excavation.
- Submit updated project schedule to EPA which reflects deferral of certain work activities to 2016.

Task A – Pre-Design and Ongoing Site Monitoring

- Inspect the St. Louis Ponds System, water levels, and free-board.

Task B – Management of Precipitation Solids in the Upper Settling Ponds

- Continue routing St. Louis Adit discharge to Pond 12.
- Continue planning for removal of remaining mining/mineral processing by-products from Upper Ponds.



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Task C – Design and Construction of a Solids Repository

- Schedule and perform a site walk and inspection of the Solids Repository with CDPHE.
- Continue work on the Solids Repository Construction Completion Report.
- Continue work for interim management of mining/mineral processing by-products.

Task D – Hydraulic Control Measures for the Collapsed Area of St. Louis Tunnel Adit

- Monitor water levels in the St. Louis Tunnel at AT-2 and BAH-01.
- Install pressure transducer in BAH-01 and perform spatial survey of BAH-01 borehole.
- Construct modifications to AT-2 overflow pipeline and implement siphon / step test on AT-2.
- Complete stabilization measures on the collapsed portion of the Adit.
- Complete evaluation of water volumes in tunnel workings and excess water flows giving rise to rising head levels.
- Implementation of this work will need to be reassessed pending results of the ongoing SLT evaluation and upcoming dewatering.

Task E – Source Water Investigations and Controls

- Download tunnel flow data for the Blaine Tunnel Flume.

Task F – Water Treatment System Analysis and Design

- Continue scoping additional data needs as necessary related to treatment system alternatives.
- Continue dewatering Pond 15.
- Perform monthly sampling, monitoring, and OM&M activities at the Constructed Demonstration Wetlands.
- Continue EWD construction.
 - Complete grading and shaping of the settling basin and manganese removal cell.
 - Complete installation of HDPE liner and geotextile on the EWD basins.
 - Commence aeration cascade subgrade preparation, Pond 14/15 embankment improvements, aeration cascade trough installation, and storm water swale construction through Pond 14.
 - Continue HDPE pipe welding and installation.
 - Continue shaping and grading storm water drainage swales and access roads.
 - Continue procurement of EWD equipment and materials.
- Hydraulic commissioning of the EWD has been rescheduled from August 15, 2015 (per the UAO schedule) to late September or October.
- A meeting with EPA will be scheduled to discuss UAO schedule modifications following hydraulic commissioning of the EWD.

If you have any questions, please feel free to contact me at (951) 265-4277.

Sincerely,



Anthony R. Brown
Project Manager
Atlantic Richfield Company

cc: R. Halsey, Atlantic Richfield
T. Moore, Atlantic Richfield
B. Johnson, Atlantic Richfield



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file: Atlantic Richfield Rico Archives, La Palma, CA
AECOM Denver Project File



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Attachment 1



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Key Performance Indicators Figures

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Figure 1
Iron, Total - Horizontal Treatment Train

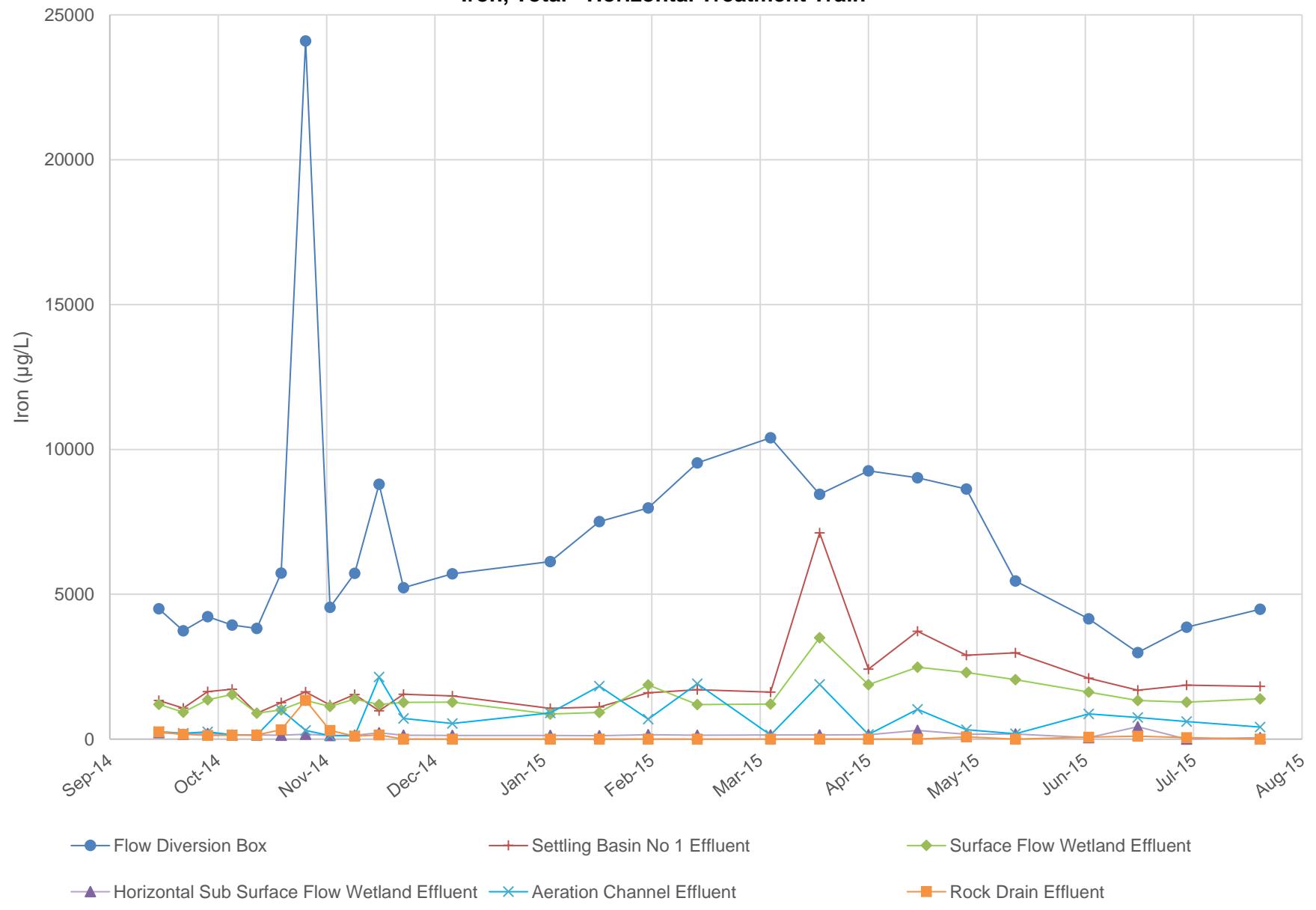


Figure 2
Iron, Total - Vertical Treatment Train

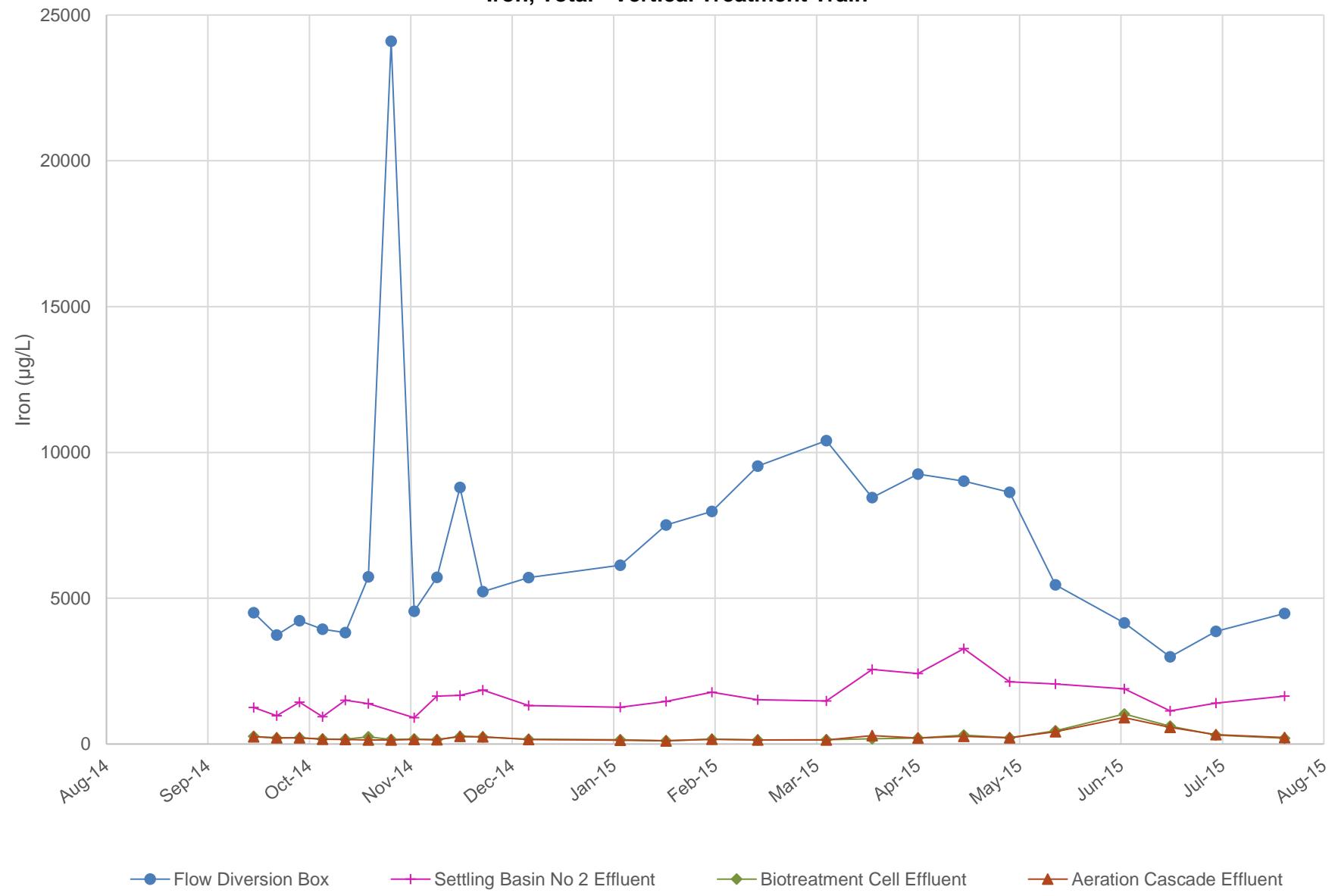


Figure 3
Iron, Dissolved - Horizontal Treatment Train

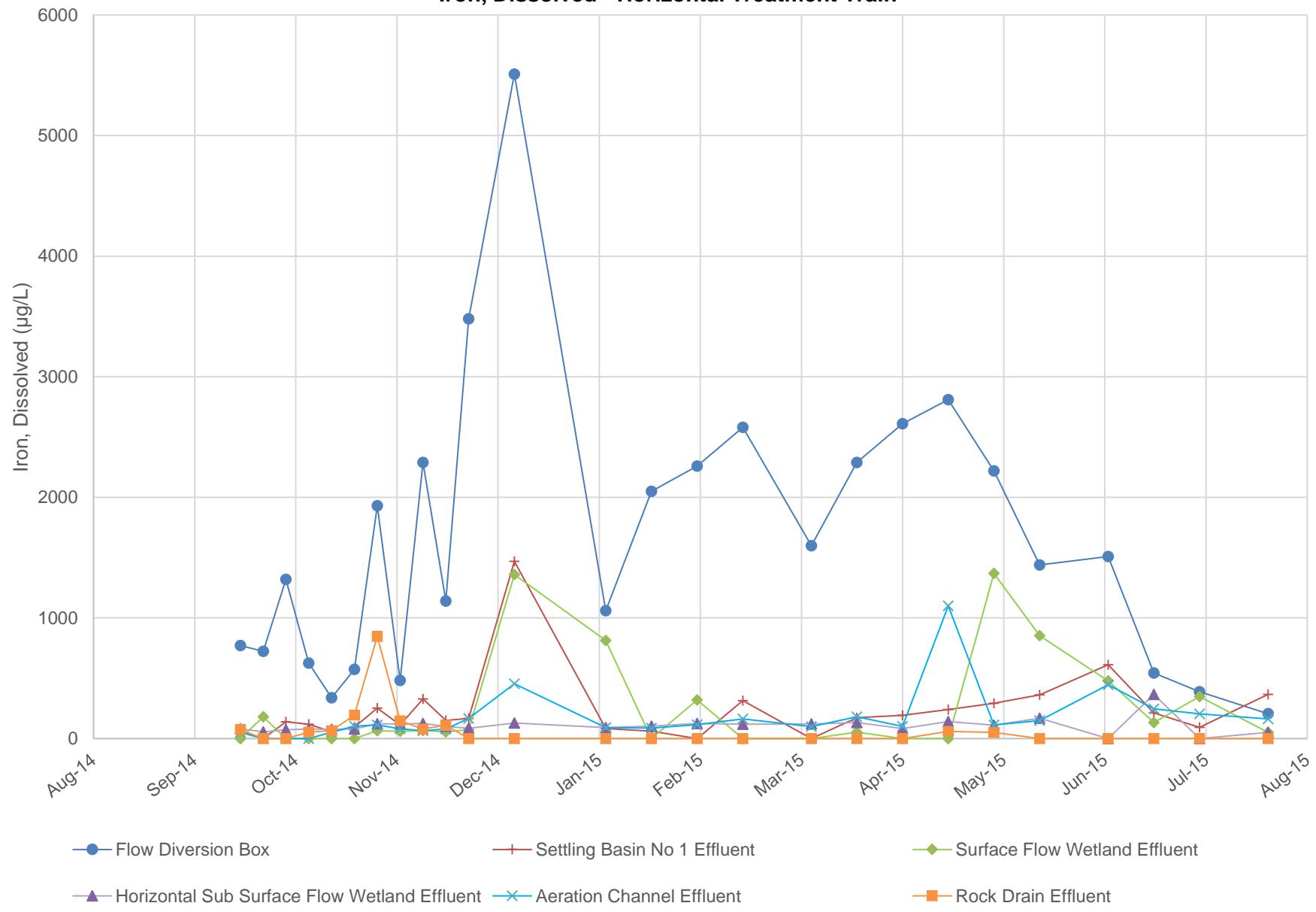


Figure 4
Iron, Dissolved - Vertical Treatment Train

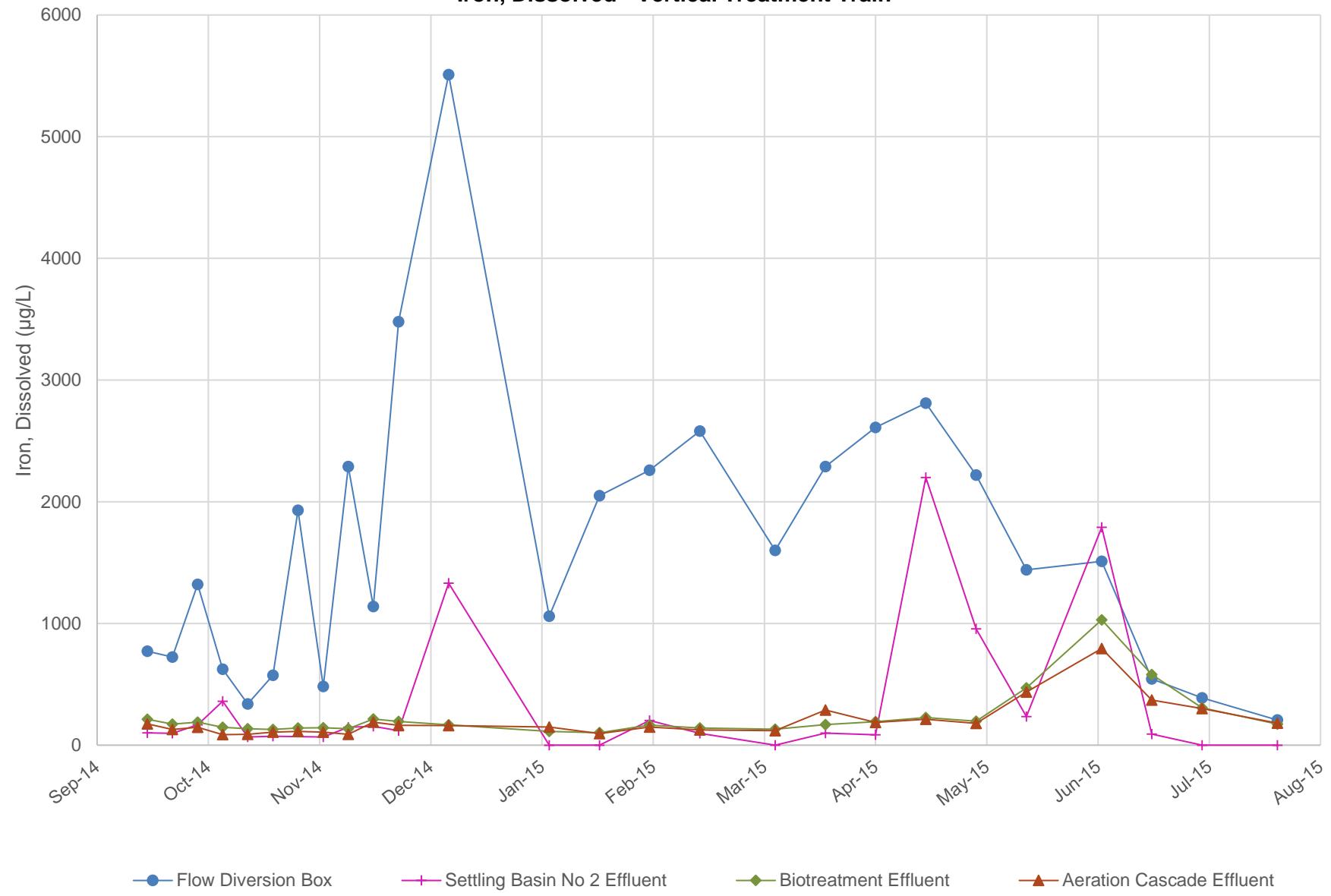


Figure 5
Cadmium, Dissolved - Horizontal Treatment Train

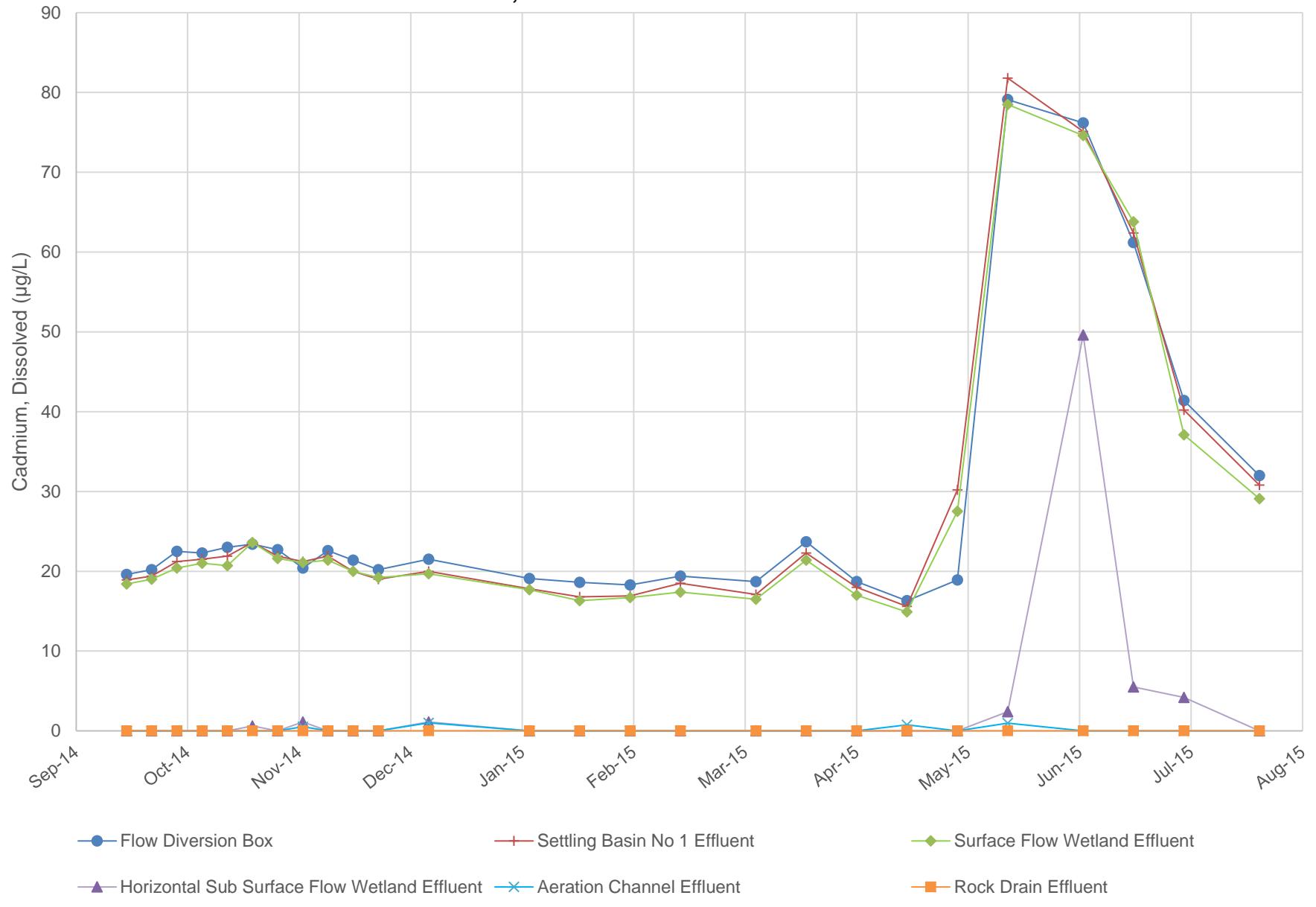


Figure 6
Cadmium, Dissolved - Vertical Treatment Train

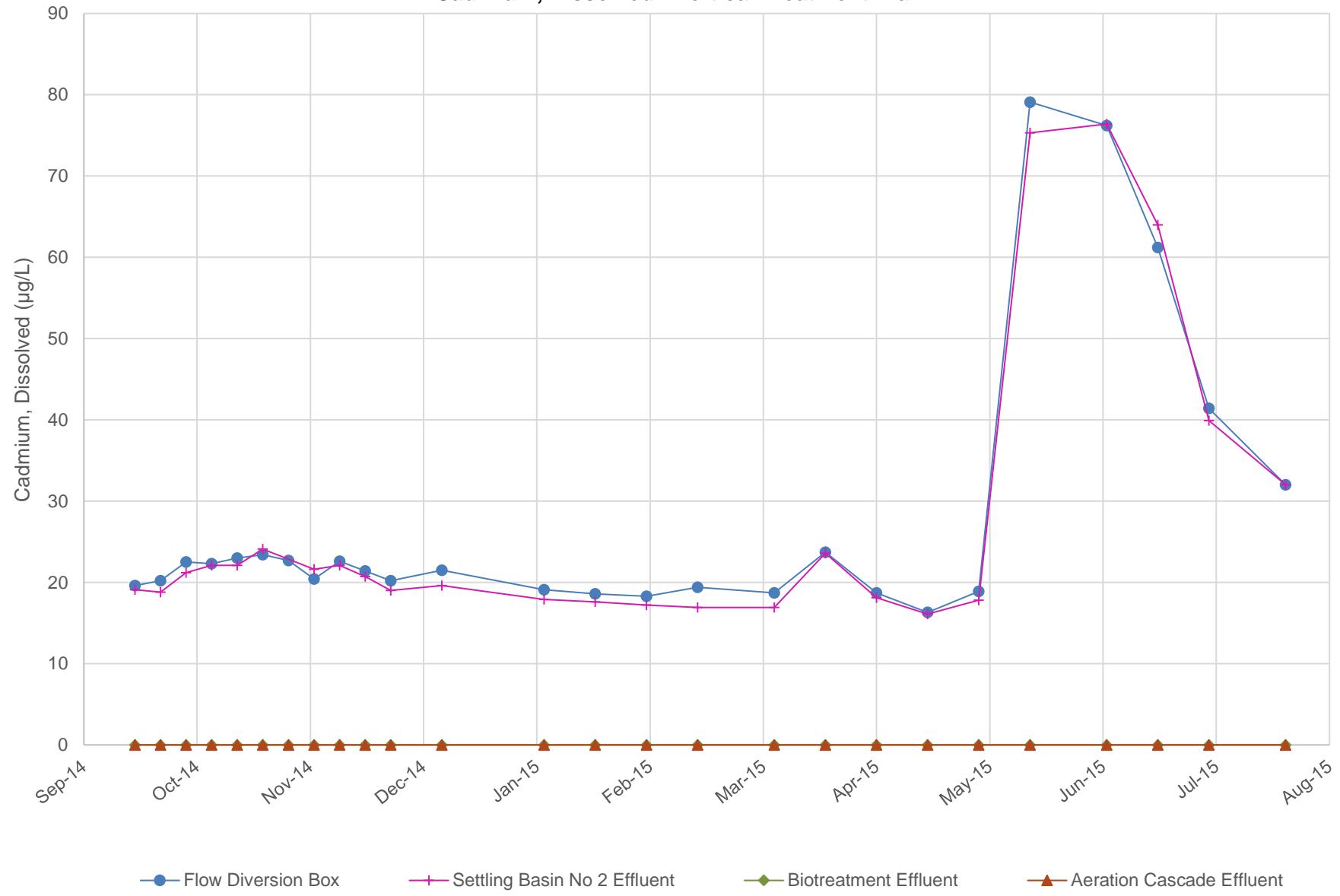


Figure 7
Zinc, Dissolved - Horizontal Treatment Train

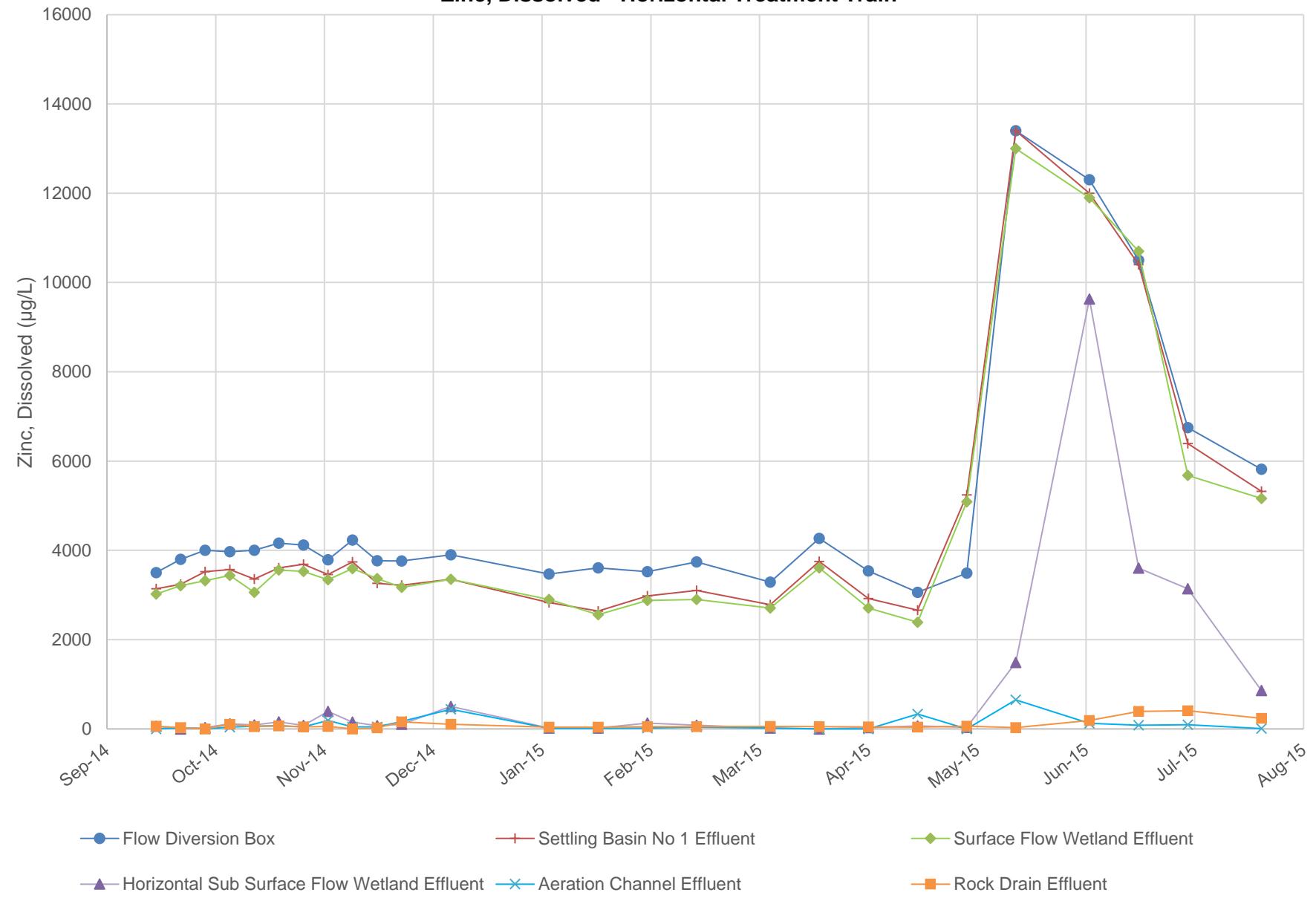


Figure 8
Zinc, Dissolved - Vertical Treatment Train

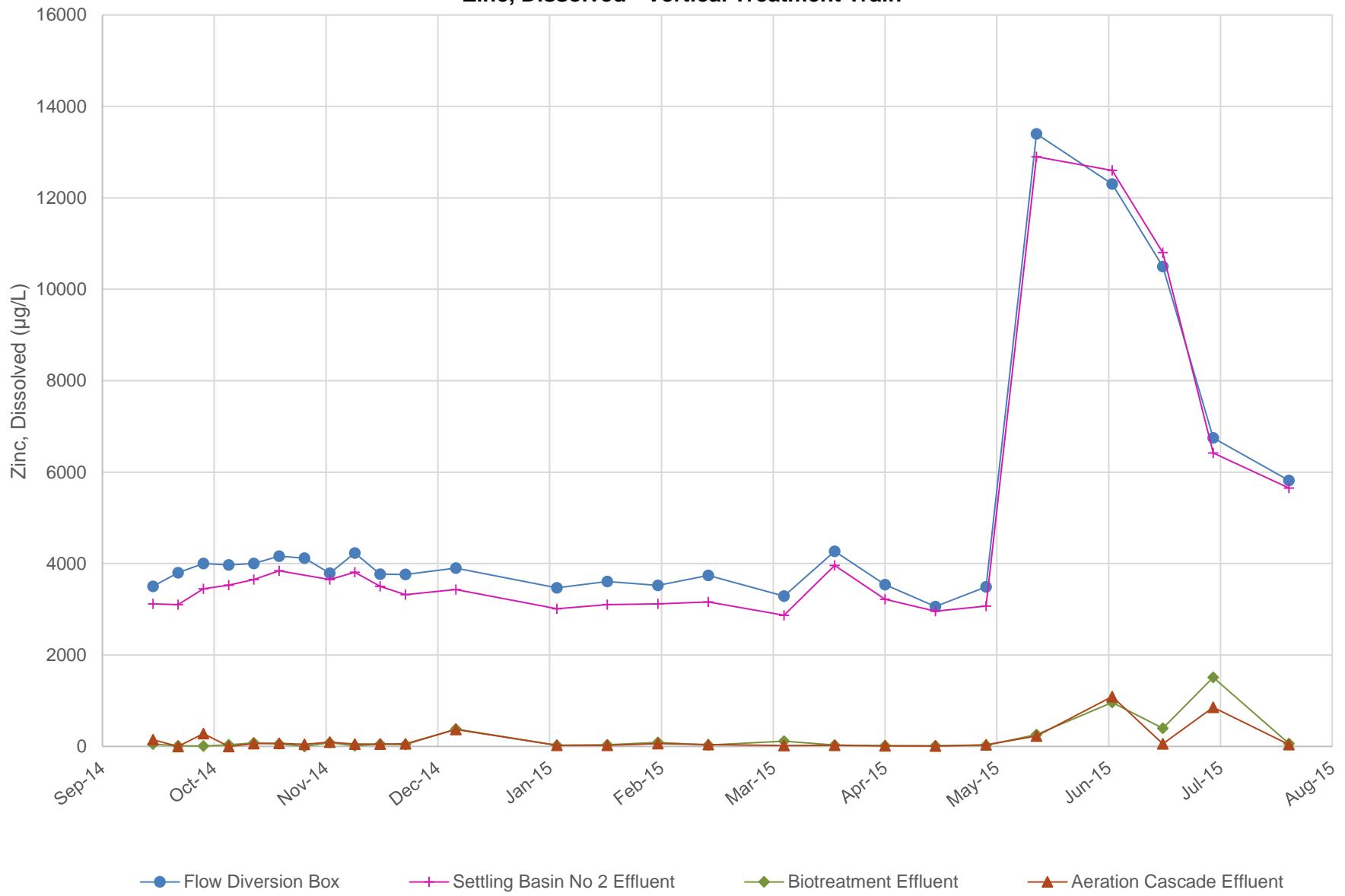


Figure 9
Manganese, Dissolved - Horizontal Treatment Train

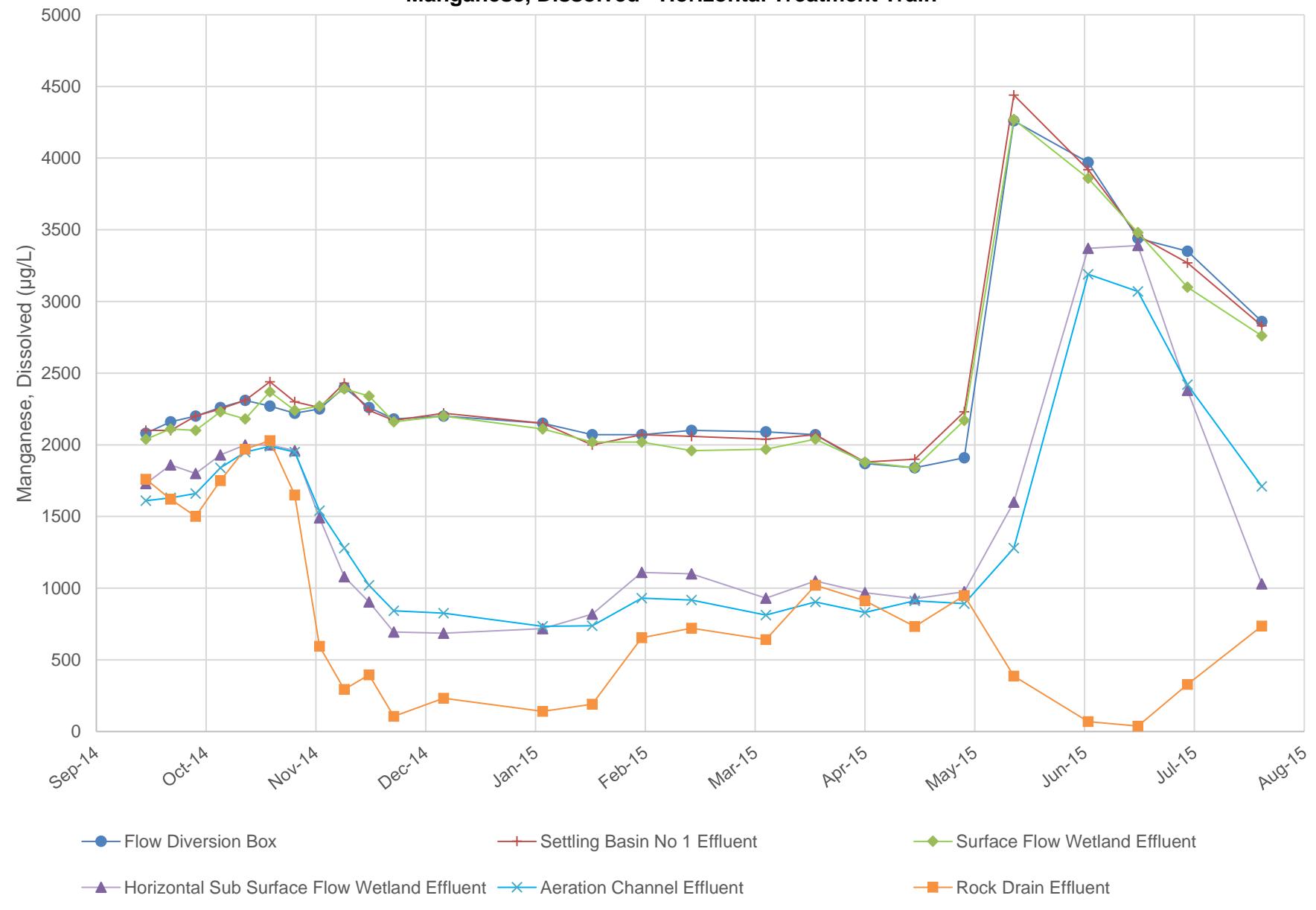
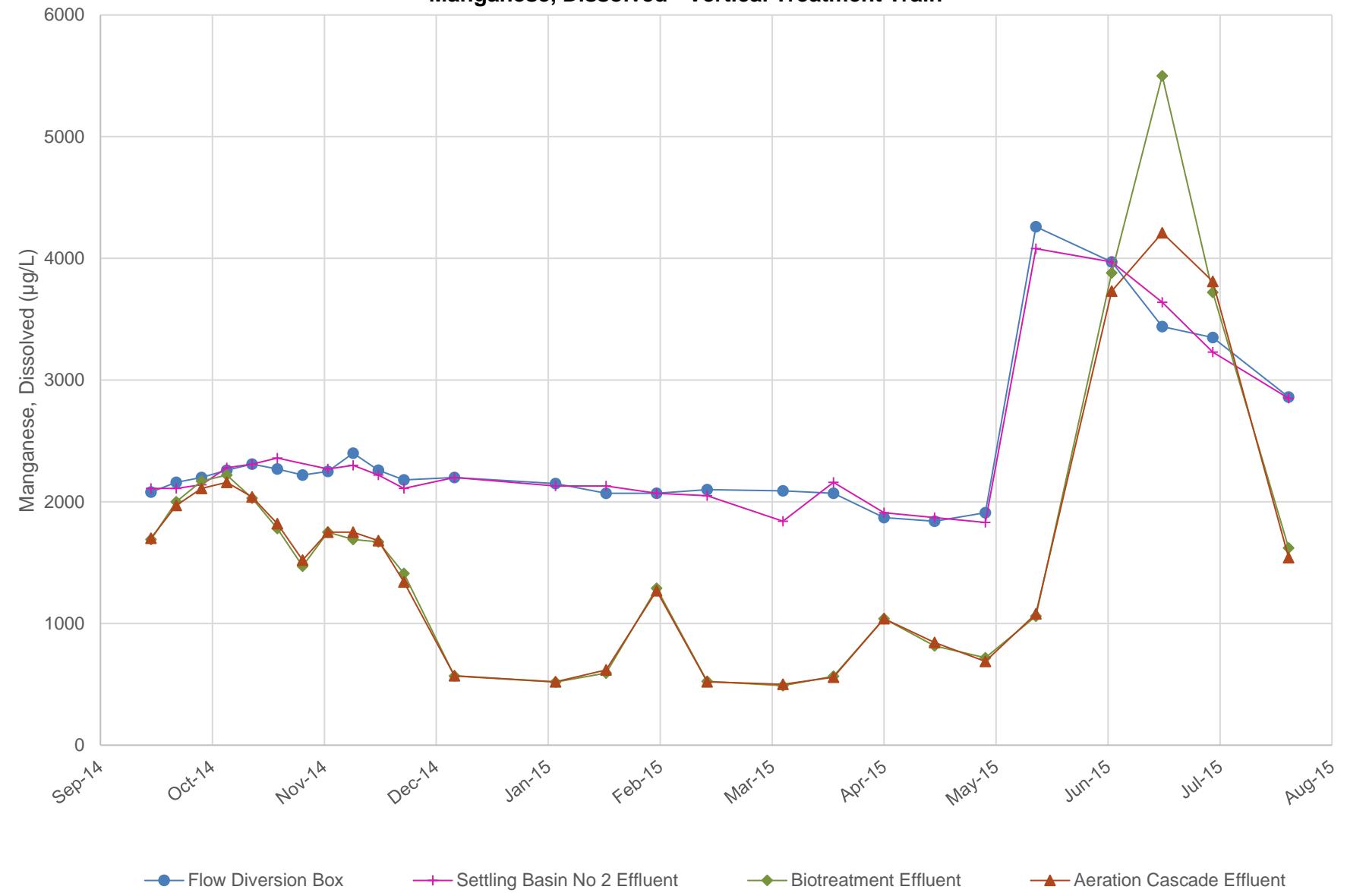


Figure 10
Manganese, Dissolved - Vertical Treatment Train



DRAWN BY: LPCjr
CHECKED: LPCjr
REVIEWED: KS
APPROVED: KS
JOB No: 1300
CAD FILE: Figure 4.dwg

DESCRIPTION

REV DATE

RESOURCE MANAGEMENT CONSULTANTS
SUITE 2A
MIDVALE, UT 84047
801-255-2626



RICO - ARGENTINE MINE SITE
ST LOUIS DISCHARGE CWDTS

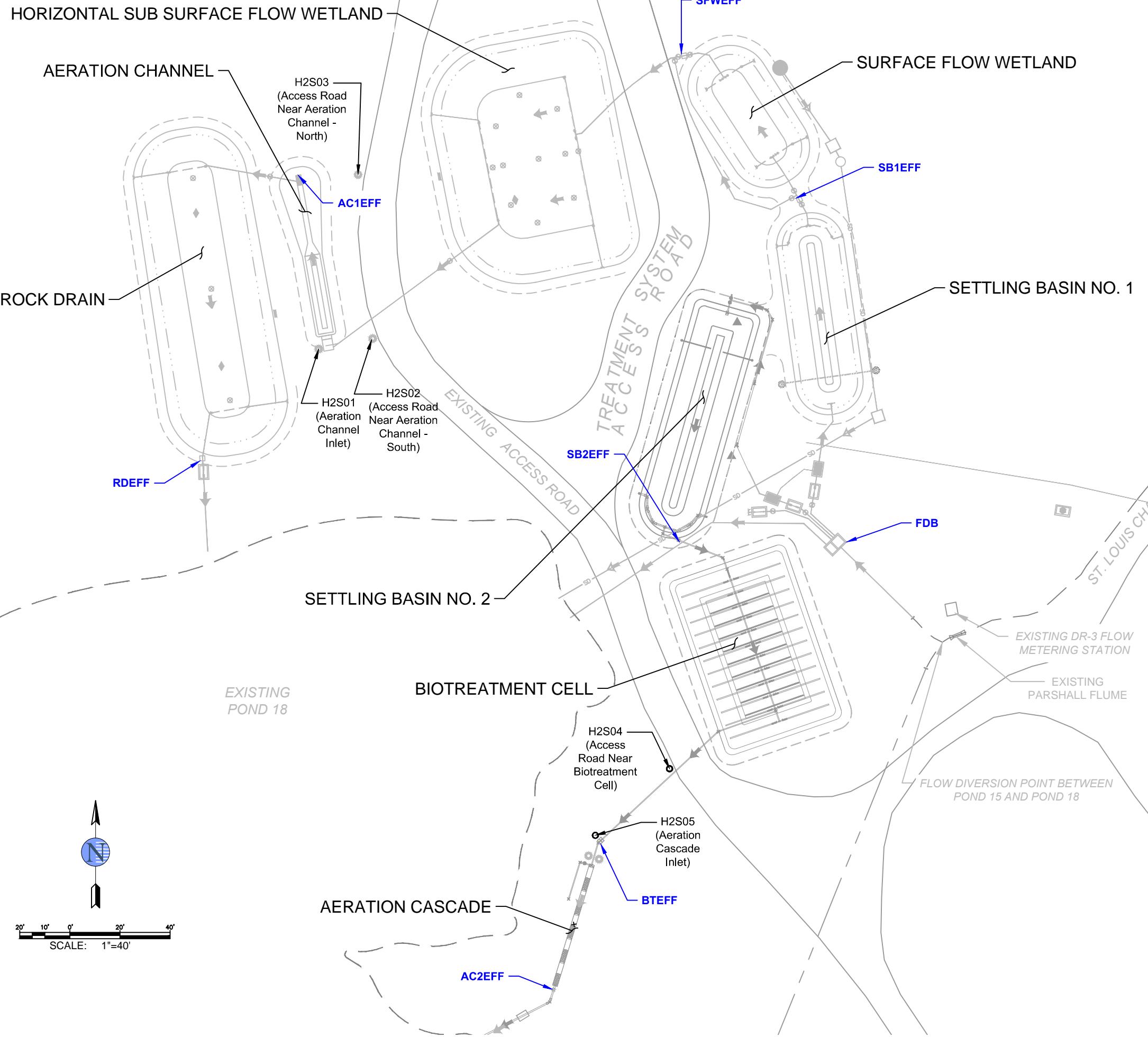
Monthly Progress Report
Monitoring Locations

AEEC

www.americanconsultants.com
3489 W 2100 S, Salt Lake City, UT 84119
801-906-5447 Fax 801-972-2741

DATE: 01 DEC 14
SCALE: 1:40
SHEET: 01 OF 01

Figure 11



Key Performance Indicators Tables

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Table 1. Iron ($\mu\text{g/L}$)

Horizontal and Vertical Wetland Treatment Trains

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H ¹ (gpm)	FLOW V ^{1,2} (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	4500	1330	1200	223	261	250	1250	266	246
C	W01	22-Sep-14	30.7	44.5	3740	1070	930	168	203	170	971	206	218
C	W02	29-Sep-14	29.5	41.3	4230	1640	1360	194	250	129	1440	216	210
C	W03	06-Oct-14	30.2	35.1	3940	1720	1540	142	156	134	937	171	165
C	W04	13-Oct-14	26.8	35.7	3820	892	900	146	138	144	1500	161	154
C	W05	20-Oct-14	29.2	35.9	5730	1260	1010	133	1010	326	1390	244	143
C	W06	27-Oct-14	27.7	43.2	24100	1630	1330	171	304	1340	R	157	137
C	W07	03-Nov-14	28.8	32.0	4550	1180	1130	126	118	297	902	175	153
C	W08	10-Nov-14	27.9	29.8	5720	1540	1380	137	115	99.6	1640	151	148
C	W09	17-Nov-14	27.9	29.2	8800	978	1190	218	2140	141	1670	253	260
C	W10	24-Nov-14	27.0	29.2	5230	1550	1270	135	712	<50	1850	236	245
C	W11	01-Dec-14	25.9	28.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	25.5	27.8	5710	1490	1280	129	538	<50	1320	164	156
C	W13	15-Dec-14	25.1	26.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W14	22-Dec-14	24.1	25.4	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W15	29-Dec-14	23.3	24.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W00	05-Jan-15	22.7	25.7	6130	1060	867	129	905	<50	1260	151	131
TR01	W01	12-Jan-15	21.6	27.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W02	19-Jan-15	20.4	25.9	7510	1110	920	117	1830	<50	1460	116	109
TR01	W03	26-Jan-15	21.9	30.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W04	02-Feb-15	27	32	7980	1600	1870	150	688	<50	1780	164	162
TR01	W05	09-Feb-15	27.8	30.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W06	16-Feb-15	28.7	29.4	9530	1710	1190	136	1910	<50	1520	143	142
TR01	W07	23-Feb-15	28.7	25.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W08	02-Mar-15	28.2	24.9	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W09	09-Mar-15	29.3	28.1	10400	1620	1210	146	140	<50	1480	148	138
TR01	W10	16-Mar-15	29.5	29.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W11	23-Mar-15	34.9	36.4	8450	7120	3500	147	1890	<50	2560	178	291
TR01	W12	30-Mar-15	34.4	38.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W00	06-Apr-15	32.3	36	9260	2420	1880	153	164	<50	2420	205	202
TR02	W01	13-Apr-15	38	39.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W02	20-Apr-15	36.7	39.3	9020	3720	2480	300	1030	<50	3270	309	261
TR02	W03	27-Apr-15	36.1	39.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W04	04-May-15	35.2	39.1	8630	2900	2300	166	327	75.8	2130	218	210
TR02	W05	11-May-15	33.4	37.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W06	18-May-15	32.0	36.6	5460	2980	2050	177	184	<50	2060	457	425
TR02	W07	25-May-16	31.9	36.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W08	01-Jun-15	31.3	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W09	08-Jun-15	30.9	35.3	4150	2100	1620	55.5	875	68.8	1890	1030	905
TR02	W10	15-Jun-15	30.8	35.6	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W11	22-Jun-15	30.9	35.7	2990	1690	1330	428	750	106	1140	613	570
TR02	W12	29-Jun-15	30.3	35.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W13	06-Jul-15	30.0	35.4	3860	1860	1280	<50	603	53.9	1400	303	323
TR02	W14	13-Jul-15	30.4	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W15	20-Jul-15	30.5	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W16	27-Jul-15	30.6	35.8	4480	1820	1390	54.8	417	<50	1640	198	224

NOTES:

Non-detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Environment Water Quality Control Commission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = horizontal treatment train average flow rate

Flow V = vertical treatment train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

NS = not sampled

OU = operable unit

RDEFF = Rock Drain Effluent

R = rejected

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

TR** = Testing Phase Test Run

 $\mu\text{g/L}$ = microgram per liter

VWTT = Vertical Wetland Treatment Train

W** = Week of Treatability Study Phase

¹ The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.² The Aeration Cascade in the VWTT was bypassed on different occasions between 27 OCT 2014 and 16 NOV 2014. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in monthly reports for the VWTT prior to DEC 2014. The flow rates for the period 27 OCT 2014 - 16 NOV 2014 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the VWTT.

Table 2. Iron, Dissolved (µg/L)

Horizontal and Vertical Wetland Treatment Trains
 St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H¹ (gpm)	FLOW V^{1,2} (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	772	56.4	<50	80.7	50.8	76.2	101	213	174
C	W01	22-Sep-14	30.7	44.5	723	<50	182	56	<50	<50	96.2	172	128
C	W02	29-Sep-14	29.5	41.3	1320	140	<50	74.1	<50	<50	166	189	147
C	W03	06-Oct-14	30.2	35.1	625	120	<50	79.8	<50	53.3	360	147	86.2
C	W04	13-Oct-14	26.8	35.7	339	58.2	<50	77	52.8	66.1	67	135	89.4
C	W05	20-Oct-14	29.2	35.9	575	96	<50	78.9	103	195	72.8	128	106
C	W06	27-Oct-14	27.7	43.2	1930	252	64.6	123	113	847	R	140	113
C	W07	03-Nov-14	28.8	32.0	483	113	59.9	122	80.5	148	66.4	143	106
C	W08	10-Nov-14	27.9	29.8	2290	329	67.6	126	64.4	79.8	147	134	90
C	W09	17-Nov-14	27.9	29.2	1140	152	54.6	101	79.2	111	154	215	188
C	W10	24-Nov-14	27.0	29.2	3480	167	73.4	85.4	168	<50	119	194	163
C	W11	01-Dec-14	25.9	28.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	25.5	27.8	5510	1470	1360	130	454	<50	1330	167	161
C	W13	15-Dec-14	25.1	26.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W14	22-Dec-14	24.1	25.4	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W15	29-Dec-14	23.3	24.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W00	05-Jan-15	22.7	25.7	1060	82.9	813	91.7	92	<50	<50	113	148
TR01	W01	12-Jan-15	21.6	27.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W02	19-Jan-15	20.4	25.9	2050	60.4	<50	103	86.9	<50	<50	102	95.6
TR01	W03	26-Jan-15	21.9	30.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W04	02-Feb-15	27.0	32.0	2260	<50	320	126	115	<50	202	164	148
TR01	W05	09-Feb-15	27.8	30.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W06	16-Feb-15	28.7	29.4	2580	314	<50	120	163	<50	97.9	141	124
TR01	W07	23-Feb-15	28.7	25.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W08	02-Mar-15	28.2	24.9	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W09	09-Mar-15	29.3	28.1	1600	<50	<50	121	100	<50	<50	130	118
TR01	W10	16-Mar-15	29.5	29.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W11	23-Mar-15	34.9	36.4	2290	173	52.9	133	182	<50	99.2	168	289
TR01	W12	30-Mar-15	34.4	38.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W00	06-Apr-15	32.3	36	2610	194	<50	82.3	101	<50	85.2	192	187
TR02	W01	13-Apr-15	38	39.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W02	20-Apr-15	36.7	39.3	2810	240	<50	141	1100	59.9	2200	226	213
TR02	W03	27-Apr-15	36.1	39.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W04	04-May-15	35.2	39.1	2220	292	1370	111	114	52.2	956	197	179
TR02	W05	11-May-15	33.4	37.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W06	18-May-15	32.0	36.6	1440	363	854	169	150	<50	235	470	436
TR02	W07	25-May-16	31.9	36.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W08	01-Jun-15	31.3	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W09	08-Jun-15	30.9	35.3	1510	612	479	<50	447	<50	1790	1030	794
TR02	W10	15-Jun-15	30.8	35.6	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W11	22-Jun-15	30.9	35.7	544	213	133	366	246	<50	92	580	371
TR02	W12	29-Jun-15	30.3	35.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W13	06-Jul-15	30.0	35.4	389	94	348	<50	204	<50	<50	306	300
TR02	W14	13-Jul-15	30.4	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W15	20-Jul-15	30.5	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W16	27-Jul-15	30.6	35.8	206	366	52.2	50.5	163	<50	<50	173	181

NOTES:

Non-detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Environment Water Quality Control Commission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = horizontal treatment train average flow rate

Flow V = vertical treatment train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

NS = not sampled

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

TR** = Test Run

µg/L = microgram per liter

VWTT = Vertical Wetland Treatment Train

W** = Week of Treatability Study Phase

¹ The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.

² The Aeration Cascade in the VWTT was bypassed on different occasions between 27 OCT 2014 and 16 NOV 2014. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in monthly reports for the VWTT prior to DEC 2014. The flow rates for the period 27 OCT 2014 - 16 NOV 2014 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the VWTT.

Table 3. Cadmium, Dissolved (µg/L)

Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H ¹ (gpm)	FLOW V ^{1,2} (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	19.6	18.9	18.4	<0.5	<0.5	<0.5	19.1	<0.5	<0.5
C	W01	22-Sep-14	30.7	44.5	20.2	19.4	19	<0.5	<0.5	<0.5	18.8	<0.5	<0.5
C	W02	29-Sep-14	29.5	41.3	22.5	21.2	20.4	<0.5	<0.5	<0.5	21.2	<0.5	<0.5
C	W03	06-Oct-14	30.2	35.1	22.3	21.5	21	<0.5	<0.5	<0.5	22.1	<0.5	<0.5
C	W04	13-Oct-14	26.8	35.7	23	21.9	20.7	<0.5	<0.5	<0.5	22.1	<0.5	<0.5
C	W05	20-Oct-14	29.2	35.9	23.4	23.6	23.6	0.6	<0.5	<0.5	24.1	<0.5	<0.5
C	W06	27-Oct-14	27.7	43.2	22.7	21.9	21.6	<0.5	<0.5	<0.5	R	<0.5	<0.5
C	W07	03-Nov-14	28.8	32.0	20.4	21.2	21.1	1.1	0.51	<0.5	21.6	<0.5	<0.5
C	W08	10-Nov-14	27.9	29.8	22.6	21.9	21.4	<0.5	<0.5	<0.5	22.1	<0.5	<0.5
C	W09	17-Nov-14	27.9	29.2	21.4	20	20	<0.5	<0.5	<0.5	20.7	<0.5	<0.5
C	W10	24-Nov-14	27.0	29.2	20.2	19	19.2	<0.5	<0.5	<0.5	19	<0.5	<0.5
C	W11	01-Dec-14	25.9	28.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	25.5	27.8	21.5	20	19.7	1.1	1	<0.5	19.6	<0.5	<0.5
C	W13	15-Dec-14	25.1	26.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W14	22-Dec-14	24.1	25.4	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W15	29-Dec-14	23.3	24.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W00	05-Jan-15	22.7	25.7	19.1	17.8	17.7	<0.5	<0.5	<0.5	17.9	<0.5	<0.5
TR01	W01	12-Jan-15	21.6	27.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W02	19-Jan-15	20.4	25.9	18.6	16.8	16.3	<0.5	<0.5	<0.5	17.6	<0.5	<0.5
TR01	W03	26-Jan-15	21.9	30.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W04	02-Feb-15	27	32	18.3	16.9	16.7	<0.5	<0.5	<0.5	17.2	<0.5	<0.5
TR01	W05	09-Feb-15	27.8	30.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W06	16-Feb-15	28.7	29.4	19.4	18.5	17.4	<0.5	<0.5	<0.5	16.9	<0.5	<0.5
TR01	W07	23-Feb-15	28.7	25.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W08	02-Mar-15	28.2	24.9	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W09	09-Mar-15	29.3	28.1	18.7	17.1	16.5	<0.5	<0.5	<0.5	16.9	<0.5	<0.5
TR01	W10	16-Mar-15	29.5	29.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W11	23-Mar-15	34.9	36.4	23.7	22.3	21.4	<0.5	<0.5	<0.5	23.6	<0.5	<0.5
TR01	W12	30-Mar-15	34.4	38.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W00	06-Apr-15	32.3	36	18.7	18	17	<0.5	<0.5	<0.5	18.1	<0.5	<0.5
TR02	W01	13-Apr-15	38	39.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W02	20-Apr-15	36.7	39.3	16.3	15.6	14.9	<0.5	0.75	<0.5	16.1	<0.5	<0.5
TR02	W03	27-Apr-15	36.1	39.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W04	04-May-15	35.2	39.1	18.9	30.2	27.5	<0.5	<0.5	<0.5	17.8	<0.5	<0.5
TR02	W05	11-May-15	33.4	37.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W06	18-May-15	32.0	36.6	79.1	81.8	78.5	2.4	0.96	<0.5	75.3	<0.5	<0.5
TR02	W07	25-May-16	31.9	36.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W08	01-Jun-15	31.3	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W09	08-Jun-15	30.9	35.3	76.2	75.1	74.6	49.6	<0.5	<0.5	76.4	<0.5	<0.5
TR02	W10	15-Jun-15	30.8	35.6	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W11	22-Jun-15	30.9	35.7	61.2	62.4	63.8	5.5	<0.5	<0.5	64	<0.5	<0.5
TR02	W12	29-Jun-15	30.3	35.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W13	06-Jul-15	30.0	35.4	41.4	40.2	37.1	4.2	<0.5	<0.5	39.9	<0.5	<0.5
TR02	W14	13-Jul-15	30.4	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W15	20-Jul-15	30.5	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W16	27-Jul-15	30.6	35.8	32	30.8	29.1	<0.08	<0.08	<0.08	32	<0.08	<0.08

NOTES:

Non-detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Environment Water Quality Control Commission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = horizontal treatment train average flow rate

Flow V = vertical treatment train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

NS = not sampled

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

TR** = Test Run

µg/L = microgram per liter

VWTT = Vertical Wetland Treatment Train

W** = Week of Treatability Study Phase

¹ The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.

² The Aeration Cascade in the VWTT was bypassed on different occasions between 27 OCT 2014 and 16 NOV 2014. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in monthly reports for the VWTT prior to DEC 2014. The flow rates for the period 27 OCT 2014 - 16 NOV 2014 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the VWTT.

Table 4. Zinc, Dissolved (µg/L)

Horizontal and Vertical Wetland Treatment Trains
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H ¹ (gpm)	FLOW V ^{1,2} (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	3500	3140	3020	60.6	<10	62.5	3120	52 J	148
C	W01	22-Sep-14	30.7	44.5	3800 J	3240	3210	<10	27	30	3100	12.8	<10
C	W02	29-Sep-14	29.5	41.3	4000	3520	3320	30.3	<10	<10	3450 J	10.8	279
C	W03	06-Oct-14	30.2	35.1	3970	3570	3440	115	37.9	102	3530	32.7	<10
C	W04	13-Oct-14	26.8	35.7	4000	3360	3060	90.4	60.5	53	3650	76.2	59.4
C	W05	20-Oct-14	29.2	35.9	4160	3610	3560	156	70	69.3	3840	56.4	65.7
C	W06	27-Oct-14	27.7	43.2	4120	3690	3530	79.9	47.8	47.9	R	<10	46.9
C	W07	03-Nov-14	28.8	32.0	3790	3460	3340	391	190	54	3650	83.3	91.7
C	W08	10-Nov-14	27.9	29.8	4230	3740	3590	152	48.3	<10	3810	15.2	49.4
C	W09	17-Nov-14	27.9	29.2	3770	3260	3370	74	44.1	23.5	3500	50.5	48.8
C	W10	24-Nov-14	27.0	29.2	3760	3220	3170	105	168	159	3320	41.8	54.5
C	W11	01-Dec-14	25.9	28.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	25.5	27.8	3900	3350	3350	503	439	106	3430	380	368
C	W13	15-Dec-14	25.1	26.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W14	22-Dec-14	24.1	25.4	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W15	29-Dec-14	23.3	24.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W00	05-Jan-15	22.7	25.7	3470	2830	2900	21.5	15.3	38.3	3010 J	26.9	26.1
TR01	W01	12-Jan-15	21.6	27.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W02	19-Jan-15	20.4	25.9	3610	2640	2560	20.7	11.1	42.7	3100	33.5	25.3
TR01	W03	26-Jan-15	21.9	30.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W04	02-Feb-15	27	32	3520	2980	2880	129	20.5	52.9	3120	89.4	63.7
TR01	W05	09-Feb-15	27.8	30.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W06	16-Feb-15	28.7	29.4	3740	3100	2900	84.8	38	48.5	3160	30.6	38.4
TR01	W07	23-Feb-15	28.7	25.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W08	02-Mar-15	28.2	24.9	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W09	09-Mar-15	29.3	28.1	3290	2780	2710	19.1	16.6	57.1	2870 J	117	16.7
TR01	W10	16-Mar-15	29.5	29.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W11	23-Mar-15	34.9	36.4	4270	3750	3610	<10	<10	52.4	3960	30.4	24.2
TR01	W12	30-Mar-15	34.4	38.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W00	06-Apr-15	32.3	36	3540	2920	2710	28.2	<10	44	3220	14.2	12.7
TR02	W01	13-Apr-15	38	39.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W02	20-Apr-15	36.7	39.3	3060	2660	2390	68.3	333	38.2	2960	12.6	10.7
TR02	W03	27-Apr-15	36.1	39.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W04	04-May-15	35.2	39.1	3490	5240	5090	32.6	<10	62.2	3070	23.2	34.7
TR02	W05	11-May-15	33.4	37.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W06	18-May-15	32.0	36.6	13400	13400	13000	1490 J	651	31.6	12900 J	257	225
TR02	W07	25-May-16	31.9	36.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W08	01-Jun-15	31.3	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W09	08-Jun-15	30.9	35.3	12300	12000	11900	9630	125	187	12600	961	1090
TR02	W10	15-Jun-15	30.8	35.6	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W11	22-Jun-15	30.9	35.7	10500	10400	10700	3600	82.9	393	10800	398	54
TR02	W12	29-Jun-15	30.3	35.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W13	06-Jul-15	30.0	35.4	6750	6390	5680	3140	96.2	408	6420	1510 J	854
TR02	W14	13-Jul-15	30.4	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W15	20-Jul-15	30.5	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W16	27-Jul-15	30.6	35.8	5820	5320 J	5160	861	11	236	5650	62.8	38.2

NOTES:

Non-detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Environment Water Quality Control Commission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = horizontal treatment train average flow rate

Flow V = vertical treatment train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

J = Estimated result

MDL = method detection limit

NS = not sampled

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

TR** = Test Run

µg/L = microgram per liter

VWTT = Vertical Wetland Treatment Train

W** = Week of Treatability Study Phase

¹ The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.

² The Aeration Cascade in the VWTT was bypassed on different occasions between 27 OCT 2014 and 16 NOV 2014. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in monthly reports for the VWTT prior to DEC 2014. The flow rates for the period 27 OCT 2014 - 16 NOV 2014 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the VWTT.

Table 5. Manganese, Dissolved (µg/L)

Horizontal and Vertical Wetland Treatment Trains

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H ¹ (gpm)	FLOW V ^{1,2} (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	2080	2100	2040 J	1730 J	1610	1760	2110	1690	1700
C	W01	22-Sep-14	30.7	44.5	2160 J	2100	2110	1860 J	1630	1620	2110	2000	1970
C	W02	29-Sep-14	29.5	41.3	2200	2200	2100	1800	1660	1500	2140 J	2170 J	2110
C	W03	06-Oct-14	30.2	35.1	2260	2250	2230	1930	1840	1750 J	2280	2220 J	2160
C	W04	13-Oct-14	26.8	35.7	2310 B	2310 B	2180 B	2000 B	1950 B	1970 B	2310 B	2030 B	2040 B
C	W05	20-Oct-14	29.2	35.9	2270	2440	2370	2000 J	1990	2030	2360	1780	1820
C	W06	27-Oct-14	27.7	43.2	2220	2300	2240	1960	1950	1650 J	R	1470	1520
C	W07	03-Nov-14	28.8	32.0	2250	2260	2270	1490	1540	594 J	2270	1750	1750
C	W08	10-Nov-14	27.9	29.8	2400	2430	2390	1080	1280	293 J	2300 J	1690 J	1750
C	W09	17-Nov-14	27.9	29.2	2260	2240	2340	904 J	1020	396 J	2220	1670	1680
C	W10	24-Nov-14	27.0	29.2	2180	2170	2160	695 J	843	106 J	2110	1410	1340
C	W11	01-Dec-14	25.9	28.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	25.5	27.8	2200	2220	2200	686	825	232	2200	568	571
C	W13	15-Dec-14	25.1	26.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W14	22-Dec-14	24.1	25.4	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W15	29-Dec-14	23.3	24.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W00	05-Jan-15	22.7	25.7	2150	2150	2110	717	734	141	2130 J	519	520
TR01	W01	12-Jan-15	21.6	27.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W02	19-Jan-15	20.4	25.9	2070	2000	2020	819 J	737	190	2130	592 J	618
TR01	W03	26-Jan-15	21.9	30.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W04	02-Feb-15	27	32	2070	2070	2020	1110	931	654	2070	1290	1270
TR01	W05	09-Feb-15	27.8	30.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W06	16-Feb-15	28.7	29.4	2100	2060	1960	1100	917	721	2050	525	521
TR01	W07	23-Feb-15	28.7	25.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W08	02-Mar-15	28.2	24.9	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W09	09-Mar-15	29.3	28.1	2090	2040	1970	930 J	812	641	1840 J	489	500
TR01	W10	16-Mar-15	29.5	29.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W11	23-Mar-15	34.9	36.4	2070	2070	2040	1050 J	904	1020	2160	566	558
TR01	W12	30-Mar-15	34.4	38.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W00	06-Apr-15	32.3	36	1870 B	1880 B	1880 B	969 B	830 B	913 B	1910 B	1040 J	1040 B
TR02	W01	13-Apr-15	38	39.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W02	20-Apr-15	36.7	39.3	1840	1900	1840	927	912	732 J	1870	816	844 J
TR02	W03	27-Apr-15	36.1	39.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W04	04-May-15	35.2	39.1	1910	2230	2170	976	893	949	1830	718	689
TR02	W05	11-May-15	33.4	37.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W06	18-May-15	32.0	36.6	4260	4440	4270	1600 J	1280	387	4080 J	1060	1080
TR02	W07	25-May-16	31.9	36.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W08	01-Jun-15	31.3	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W09	08-Jun-15	30.9	35.3	3970	3920	3860	3370	3190 J	69.8	3970	3880	3730
TR02	W10	15-Jun-15	30.8	35.6	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W11	22-Jun-15	30.9	35.7	3440 B	3460 B	3480 B	3390 B	3070 J	37.9 B	3640 B	5500 B	4210 B
TR02	W12	29-Jun-15	30.3	35.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W13	06-Jul-15	30.0	35.4	3350	3270	3100	2380	2420	328	3230	3720 J	3810
TR02	W14	13-Jul-15	30.4	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W15	20-Jul-15	30.5	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W16	27-Jul-15	30.6	35.8	2860	2830 J	2760	1030	1710	736	2850	1620	1540

NOTES:

Non-detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Environment Water Quality Control Commission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

B = Analyte is detected in an associated blank

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = horizontal treatment train average flow rate

Flow V = vertical treatment train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

J = Estimated result

MDL = method detection limit

NS = not sampled

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

TR** = Test Run

µg/L = microgram per liter

VWTT = Vertical Wetland Treatment Train

W** = Week of Treatability Study Phase

¹ The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.² The Aeration Cascade in the VWTT was bypassed on different occasions between 27 OCT 2014 and 16 NOV 2014. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in monthly reports for the VWTT prior to DEC 2014. The flow rates for the period 27 OCT 2014 - 16 NOV 2014 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the VWTT.

Table 6. Total Suspended Solids (mg/L)

Horizontal and Vertical Wetland Treatment Trains

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H ¹ (gpm)	FLOW V ^{1,2} (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	6	<5	<5	<5	<5	<5	<5	<5	<5
C	W01	22-Sep-14	30.7	44.5	6	12	<5	<5	6	<5	<5	<5	<5
C	W02	29-Sep-14	29.5	41.3	8	<5	6	<5	10	<5	9	<5	<5
C	W03	06-Oct-14	30.2	35.1	<5	<5	6	<5	<5	<5	<5	<5	<5
C	W04	13-Oct-14	26.8	35.7	11	10	14	<5	5	<5	15	<5	<5
C	W05	20-Oct-14	29.2	35.9	17	7	9	<5	22	<5	12	6	12
C	W06	27-Oct-14	27.7	43.2	<5	7	<5	<5	<5	5	R	<5	<5
C	W07	03-Nov-14	28.8	32.0	11	6	8	<5	<5	<5	<5	<5	<5
C	W08	10-Nov-14	27.9	29.8	<5	7	6	<5	<5	<5	11	5	10
C	W09	17-Nov-14	27.9	29.2	12	13	15	80	30	11	15	<5	14
C	W10	24-Nov-14	27.0	29.2	42	10	7	<5	15	<5	7	6	14
C	W11	01-Dec-14	25.9	28.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	25.5	27.8	14	9	<5	<5	<5	<5	<5	<5	<5
C	W13	15-Dec-14	25.1	26.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W14	22-Dec-14	24.1	25.4	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W15	29-Dec-14	23.3	24.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W00	05-Jan-15	22.7	25.7	9	6	9	7	10	8	<5	7	8
TR01	W01	12-Jan-15	21.6	27.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W02	19-Jan-15	20.4	25.9	16	5	6	<5	18	<5	6	<5	<5
TR01	W03	26-Jan-15	21.9	30.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W04	02-Feb-15	27	32	20	11	10	<5	14	6	<5	<5	<5
TR01	W05	09-Feb-15	27.8	30.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W06	16-Feb-15	28.7	29.4	24	12	6	5	8	<5	6	<5	<5
TR01	W07	23-Feb-15	28.7	25.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W08	02-Mar-15	28.2	24.9	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W09	09-Mar-15	29.3	28.1	29	10	11	6	8	5	<5	9	7
TR01	W10	16-Mar-15	29.5	29.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W11	23-Mar-15	34.9	36.4	28	38	19	11	53	9	15	9	18
TR01	W12	30-Mar-15	34.4	38.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W00	06-Apr-15	32.3	36	13	7	7	<5	6	<5	<5	8	9
TR02	W01	13-Apr-15	38	39.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W02	20-Apr-15	36.7	39.3	17	14	<5	<5	<5	6	8	<5	7
TR02	W03	27-Apr-15	36.1	39.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W04	04-May-15	35.2	39.1	27	<5	6	<5	10	<5	10	7	7
TR02	W05	11-May-15	33.4	37.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W06	18-May-15	32.0	36.6	16	5	11	<5	<5	R	<5	<5	<5
TR02	W07	25-May-16	31.9	36.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W08	01-Jun-15	31.3	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W09	08-Jun-15	30.9	35.3	6	6	6	<5	7	<5	<5	6	6
TR02	W10	15-Jun-15	30.8	35.6	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W11	22-Jun-15	30.9	35.7	8	10	<5	5	5	<5	10	6	6
TR02	W12	29-Jun-15	30.3	35.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W13	06-Jul-15	30.0	35.4	12	9	<5	<5	9	<5	5	13	12
TR02	W14	13-Jul-15	30.4	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W15	20-Jul-15	30.5	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W16	27-Jul-15	30.6	35.8	10	10	6	<5	6	<5	6	<5	<5

NOTES:

Non-detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Environment Water Quality Control Commission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = Horizontal Treatment Train average flow rate

Flow V = Vertical Treatment Train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

mg/L = milligram per liter

NS = not sampled

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

TR** = Test Run

VWTT = Vertical Wetland Treatment Train

W** = Week of Treatability Study Phase

¹ The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.² The Aeration Cascade in the VWTT was bypassed on different occasions between 27 OCT 2014 and 16 NOV 2014. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in monthly reports for the VWTT prior to DEC 2014. The flow rates for the period 27 OCT 2014 - 16 NOV 2014 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the VWTT.

Table 7. Total Organic Carbon (mg/L)

Horizontal and Vertical Wetland Treatment Trains

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H ¹ (gpm)	FLOW V ^{1,2} (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	NR	<1	<1	12.7	24.9	21.5	<1	38	31.6
C	W01	22-Sep-14	30.7	44.5	NR	1.3	<1	6.8	11.7	12.5	1	21	19.7
C	W02	29-Sep-14	29.5	41.3	NR	<1	<1	5.9	9	9.1	1.3	10.6	9.2
C	W03	06-Oct-14	30.2	35.1	NR	<1	<1	4.2	7.4	7.6	<1	9.2	7.8
C	W04	13-Oct-14	26.8	35.7	NR	<1	<1	3.2	4.9	5.2	1.1	6.2 J	5.3
C	W05	20-Oct-14	29.2	35.9	NR	<1	<1	3	4.2	4.4	<1	4.6	4.4
C	W06	27-Oct-14	27.7	43.2	NR	<1	<1	2.9	4	6.5	R	3.5	3.3
C	W07	03-Nov-14	28.8	32.0	NR	<1	<1	1.6	2.6	2.5	<1	2.6	2.6
C	W08	10-Nov-14	27.9	29.8	NR	<1	<1	1.6	2.5	2.1	<1	2.4	2.4
C	W09	17-Nov-14	27.9	29.2	NR	<1	<1	1.7	2.5	2	<1	2.5	2.4
C	W10	24-Nov-14	27.0	29.2	NR	<1	<1	1.3	2.2	1.5	<1	2.3	2.5
C	W11	01-Dec-14	25.9	28.5	NR	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	25.5	27.8	NR	<1	1.8	1.8	2.8	1.6	<1	2	1.9
C	W13	15-Dec-14	25.1	26.2	NR	NS	NS	NS	NS	NS	NS	NS	NS
C	W14	22-Dec-14	24.1	25.4	NR	NS	NS	NS	NS	NS	NS	NS	NS
C	W15	29-Dec-14	23.3	24.5	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W00	05-Jan-15	22.7	25.7	NR	<1	<1	1.5	2.4	1.4 J	<1	1.9	2.1
TR01	W01	12-Jan-15	21.6	27.3	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W02	19-Jan-15	20.4	25.9	NR	<1	<1	1.3	1.7	1.2 J	<1	1.6	1.7
TR01	W03	26-Jan-15	21.9	30.8	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W04	02-Feb-15	27	32	NR	<1	<1	1.3	1.6	1.3	<1	1.9	2.6
TR01	W05	09-Feb-15	27.8	30.3	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W06	16-Feb-15	28.7	29.4	NR	<1	<1	1.2	1.3	1.1	<1	1.1	1.2
TR01	W07	23-Feb-15	28.7	25.2	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W08	02-Mar-15	28.2	24.9	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W09	09-Mar-15	29.3	28.1	NR	<1	<1	1.1	1.6	1.3	<1	1.3	1.4
TR01	W10	16-Mar-15	29.5	29.7	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W11	23-Mar-15	34.9	36.4	NR	<1	<1	<1	1.4	1.2	<1	1.9	2.4
TR01	W12	30-Mar-15	34.4	38.5	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W00	06-Apr-15	32.3	36	NR	<1	<1	<1	1.1	<1	<1	<1	<1
TR02	W01	13-Apr-15	38	39.8	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W02	20-Apr-15	36.7	39.3	NR	<1	<1	2.7	1.1	<1	<1	<1	1
TR02	W03	27-Apr-15	36.1	39.3	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W04	04-May-15	35.2	39.1	NR	<1	<1	<1	1.5	1.7	<1	1.4	1.3
TR02	W05	11-May-15	33.4	37.8	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W06	18-May-15	32.0	36.6	NR	<1	<1	<1	1.1	<1	<1	<1	<1
TR02	W07	25-May-16	31.9	36.2	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W08	01-Jun-15	31.3	35.7	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W09	08-Jun-15	30.9	35.3	NR	<1	<1	1.1	3	2.4	<1	1.1	1.3
TR02	W10	15-Jun-15	30.8	35.6	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W11	22-Jun-15	30.9	35.7	NR	<1	<1	1.6	2.3	1.5	<1	1.1	1.1
TR02	W12	29-Jun-15	30.3	35.5	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W13	06-Jul-15	30.0	35.4	NR	<1	<1	1.4	2.7	1.8	<1	1.1	1
TR02	W14	13-Jul-15	30.4	35.7	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W15	20-Jul-15	30.5	35.7	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W16	27-Jul-15	30.6	35.8	NR	<1	<1	<1	2	1.4	<1	<1	<1

NOTES:

Non-detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Environment Water Quality Control Commission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = Horizontal Treatment Train average flow rate

Flow V = Vertical Treatment Train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

J = Estimated result

MDL = method detection limit

mg/L = milligram per liter

NR = not required

NS = not sampled

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

TR** = Test Run

VWTT = Vertical Wetland Treatment Train

W** = Week of Treatability Study Phase

¹The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.²The Aeration Cascade in the VWTT was bypassed on different occasions between 27 OCT 2014 and 16 NOV 2014. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in monthly reports for the VWTT prior to DEC 2014. The flow rates for the period 27 OCT 2014 - 16 NOV 2014 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the VWTT.

Table 8. Biological Oxygen Demand, 5 day (mg/L)

Horizontal and Vertical Wetland Treatment Trains

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H ¹ (gpm)	FLOW V ^{1/2} (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	NR	<2	<2	29.3	R	R	<2	77.4	53.4
C	W01	22-Sep-14	30.7	44.5	NR	<2	<2	22.1	30.3	18.8	<2	29.3	28.1
C	W02	29-Sep-14	29.5	41.3	NR	<2	<2	9.4	23.8	10.3	<2	20.3	10.9
C	W03	06-Oct-14	30.2	35.1	NR	<2	<2	7.8	15.7	9.7	<2	20.1	12.6
C	W04	13-Oct-14	26.8	35.7	NR	<2	<2	2.8	7.6	4.5	<2	16.4	17.2
C	W05	20-Oct-14	29.2	35.9	NR	<2	<2	<2	3.5	2.6	<2	10.9	15.7
C	W06	27-Oct-14	27.7	43.2	NR	<2	<2	3.1	2	<2	<2	11.5	8.4
C	W07	03-Nov-14	28.8	32.0	NR	<2	<2	2	2.6	2.3	<2	8	4.7
C	W08	10-Nov-14	27.9	29.8	NR	<2	<2	2.1	2	<2	<2	9.7	3.5
C	W09	17-Nov-14	27.9	29.2	NR	<2	<2	2.9	<2	2	<2	9.6	6.4
C	W10	24-Nov-14	27.0	29.2	NR	<2	<2	3.2	4.2	<2	<2	7.8	4.2
C	W11	01-Dec-14	25.9	28.5	NR	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	25.5	27.8	NR	<2	<2	5.1	3.8	<2	<2	6.5	2.6
C	W13	15-Dec-14	25.1	26.2	NR	NS	NS	NS	NS	NS	NS	NS	NS
C	W14	22-Dec-14	24.1	25.4	NR	NS	NS	NS	NS	NS	NS	NS	NS
C	W15	29-Dec-14	23.3	24.5	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W00	05-Jan-15	22.7	25.7	NR	<2	<2	5.1	2.4	<2	<2	3.6	2.4
TR01	W01	12-Jan-15	21.6	27.3	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W02	19-Jan-15	20.4	25.9	NR	<2	<2	4.9	3.1	<2	<2	5.2	<2
TR01	W03	26-Jan-15	21.9	30.8	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W04	02-Feb-15	27	32	NR	<2	<2	7.6	6.3	<2	<2	5.3	3.1
TR01	W05	09-Feb-15	27.8	30.3	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W06	16-Feb-15	28.7	29.4	NR	<2	<2	<2	2.1	<2	<2	4.4	<2
TR01	W07	23-Feb-15	28.7	25.2	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W08	02-Mar-15	28.2	24.9	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W09	09-Mar-15	29.3	28.1	NR	<2	<2	6.4	2	<2	<2	4.8	2.6
TR01	W10	16-Mar-15	29.5	29.7	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W11	23-Mar-15	34.9	36.4	NR	<2	<2	2.3	6	<2	<2	3.7	2.9
TR01	W12	30-Mar-15	34.4	38.5	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W00	06-Apr-15	32.3	36	NR	<2	<2	3.2	<2	<2	<2	2.8	<2
TR02	W01	13-Apr-15	38	39.8	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W02	20-Apr-15	36.7	39.3	NR	<2	<2	2.5	<2	<2	<2	3	<2
TR02	W03	27-Apr-15	36.1	39.3	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W04	04-May-15	35.2	39.1	NR	<2	<2	<2	<2	<2	<2	2.1	<2
TR02	W05	11-May-15	33.4	37.8	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W06	18-May-15	32.0	36.6	NR	<2	<2	<2	<2	R	<2	<2	<2
TR02	W07	25-May-16	31.9	36.2	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W08	01-Jun-15	31.3	35.7	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W09	08-Jun-15	30.9	35.3	NR	<2	<2	<2	<2	<2	<2	<2	<2
TR02	W10	15-Jun-15	30.8	35.6	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W11	22-Jun-15	30.9	35.7	NR	<2	<2	<2	2.4	<2	<2	3.2	<2
TR02	W12	29-Jun-15	30.3	35.5	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W13	06-Jul-15	30.0	35.4	NR	<2	<2	2	2.1	<2	<2	2.5	<2
TR02	W14	13-Jul-15	30.4	35.7	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W15	20-Jul-15	30.5	35.7	NR	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W16	27-Jul-15	30.6	35.8	NR	<2	<2	<2	<2	<2	<2	<2	<2

NOTES:

Non-detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Environment Water Quality Control Commission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = Horizontal Treatment Train average flow rate

Flow V = Vertical Treatment Train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

mg/L = milligram per liter

NR = not required

NS = not sampled

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

TR** = Test Run

VWTT = Vertical Wetland Treatment Train

W** = Week of Treatability Study Phase

¹The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.²The Aeration Cascade in the VWTT was bypassed on different occasions between 27 OCT 2014 and 16 NOV 2014. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in monthly reports for the VWTT prior to DEC 2014. The flow rates for the period 27 OCT 2014 - 16 NOV 2014 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the VWTT.

Table 9. Sulfate (mg/L)

Horizontal and Vertical Wetland Treatment Trains

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site - Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H ¹ (gpm)	FLOW V ^{1,2} (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	595	579	575	603	551	571	571	497	523
C	W01	22-Sep-14	30.7	44.5	710	650	724	637	620	555 J	589	582	656
C	W02	29-Sep-14	29.5	41.3	574	615	612	605	587	565	613	573	580 J
C	W03	06-Oct-14	30.2	35.1	570	630	618	707	580	618	622	522	562
C	W04	13-Oct-14	26.8	35.7	632	637	647	660	655	648	644	615 J	612
C	W05	20-Oct-14	29.2	35.9	555	551	584	558	557	574	545	543	552
C	W06	27-Oct-14	27.7	43.2	629	614	596	625	637	673	R	602	606
C	W07	03-Nov-14	28.8	32.0	536	514	526	552	542	535	536	530	525
C	W08	10-Nov-14	27.9	29.8	616	623	640	617	644	815	627	646	657
C	W09	17-Nov-14	27.9	29.2	601	635	584	587 J	901	683	606	591	574
C	W10	24-Nov-14	27.0	29.2	638	662	636	685	749	680	654	674	638
C	W11	01-Dec-14	25.9	28.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	25.5	27.8	645	623	633	672	687	614	663	597	625
C	W13	15-Dec-14	25.1	26.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W14	22-Dec-14	24.1	25.4	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W15	29-Dec-14	23.3	24.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W00	05-Jan-15	22.7	25.7	673	646	707	631	668	701	652	648	645
TR01	W01	12-Jan-15	21.6	27.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W02	19-Jan-15	20.4	25.9	670	565	582	596	600	617	678	639	801 J
TR01	W03	26-Jan-15	21.9	30.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W04	02-Feb-15	27	32	650	608	623	617	612	609	583	652	653
TR01	W05	09-Feb-15	27.8	30.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W06	16-Feb-15	28.7	29.4	601	664	637	661	709	670	687	642	656
TR01	W07	23-Feb-15	28.7	25.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W08	02-Mar-15	28.2	24.9	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W09	09-Mar-15	29.3	28.1	613	629	658	631	629	626	703 J	639	594
TR01	W10	16-Mar-15	29.5	29.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W11	23-Mar-15	34.9	36.4	672	654	760	703	678	672	659	639	631
TR01	W12	30-Mar-15	34.4	38.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W00	06-Apr-15	32.3	36	613	703	685	674	631	678	678	648	604 J
TR02	W01	13-Apr-15	38	39.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W02	20-Apr-15	36.7	39.3	616	623	623	631	641	637	631	625	637
TR02	W03	27-Apr-15	36.1	39.3	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W04	04-May-15	35.2	39.1	660	640	646	636	748	630	606	601	595
TR02	W05	11-May-15	33.4	37.8	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W06	18-May-15	32.0	36.6	718	712	716	708	705	R	708	682	725
TR02	W07	25-May-16	31.9	36.2	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W08	01-Jun-15	31.3	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W09	08-Jun-15	30.9	35.3	688	692	748	711	689	760	689	664	675
TR02	W10	15-Jun-15	30.8	35.6	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W11	22-Jun-15	30.9	35.7	638	644	638	639	633	638	631	624	661
TR02	W12	29-Jun-15	30.3	35.5	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W13	06-Jul-15	30.0	35.4	615	600	573	604	571	564	619	600	594
TR02	W14	13-Jul-15	30.4	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W15	20-Jul-15	30.5	35.7	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W16	27-Jul-15	30.6	35.8	519	523	528	526	529	530	520	524	524

NOTES:

Non-detects are reported as less than the laboratory Reporting Limit (RL) and estimated as zero for calculations and graphing (Colorado Department of Public Health and Environment Water Quality Control Commission 5 CCR 1002-34).

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = Horizontal Treatment Train average flow rate

Flow V = Vertical Treatment Train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

J = Estimated result

MDL = method detection limit

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

TR* = Test Run

VWTT = Vertical Wetland Treatment Train

W** = Week of Treatability Study Phase

¹The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.²The Aeration Cascade in the VWTT was bypassed on different occasions between 27 OCT 2014 and 16 NOV 2014. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in monthly reports for the VWTT prior to DEC 2014. The flow rates for the period 27 OCT 2014 - 16 NOV 2014 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the VWTT.

Table 10. Turbidity (NTU)

Horizontal and Vertical Wetland Treatment Trains
 St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H ¹ (gpm)	FLOW V ^{1,2} (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	18	3	5	R	44	7	8	R	R
C	W01	22-Sep-14	30.7	44.5	18	7	4	11	49	13	4	3	13
C	W02	29-Sep-14	29.5	41.3	22	8	7	8	35	35	7	7	16
C	W03	06-Oct-14	30.2	35.1	NM	7	6	9	32	48	5	6	26
C	W04	13-Oct-14	26.8	35.7	31	8	7	14	56	47	12	7	35
C	W05	20-Oct-14	29.2	35.9	39	9	8	11	60	14	11	9	103
C	W06	27-Oct-14	27.7	43.2	38	9	6	7	33	14	5	5	38
C	W07	03-Nov-14	28.8	32.0	38	9	8	5	21	3	6	3	28
C	W08	10-Nov-14	27.9	29.8	31	5	6	2	25	0	4	5	19
C	W09	17-Nov-14	27.9	29.2	30	8	7	5	23	2	8	5	25
C	W10	24-Nov-14	27.0	29.2	46	59	17	8	43	1	7	17	146
C	W11	01-Dec-14	25.9	28.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W12	08-Dec-14	25.5	27.8	33	7	6	2	31	0	8	5	44
C	W13	15-Dec-14	25.1	26.2	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W14	22-Dec-14	24.1	25.4	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W15	29-Dec-14	23.3	24.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W00	05-Jan-15	22.7	25.7	33	12	4	4	38	1	14	3	37
TR01	W01	12-Jan-15	21.6	27.3	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W02	19-Jan-15	20.4	25.9	31	40	4	3	47	1	16	3	33
TR01	W03	26-Jan-15	21.9	30.8	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W04	02-Feb-15	27	32	29	9	6	4	44	3	9	4	22
TR01	W05	09-Feb-15	27.8	30.3	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W06	16-Feb-15	28.7	29.4	38	11	6	4	50	2	6	3	23
TR01	W07	23-Feb-15	28.7	25.2	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W08	02-Mar-15	28.2	24.9	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W09	09-Mar-15	29.3	28.1	45	6	4	3	41	3	5	1	23
TR01	W10	16-Mar-15	29.5	29.7	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W11	23-Mar-15	34.9	36.4	42	42	19	5	78	1	12	4	22
TR01	W12	30-Mar-15	34.4	38.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W00	06-Apr-15	32.3	36	32	14	24	4	26	0	14	3	14
TR02	W01	13-Apr-15	38	39.8	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W02	20-Apr-15	36.7	39.3	28	16	11	4	26	2	12	2	28
TR02	W03	27-Apr-15	36.1	39.3	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W04	04-May-15	35.2	39.1	28	11	9	4	21	1	8	2	11
TR02	W05	11-May-15	33.4	37.8	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W06	18-May-15	32.0	36.6	26	15	13	19	28	R	10	5	12
TR02	W07	25-May-16	31.9	36.2	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W08	01-Jun-15	31.3	35.7	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W09	08-Jun-15	30.9	35.3	22	12	35	35	60	6	10	17	17
TR02	W10	15-Jun-15	30.8	35.6	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W11	22-Jun-15	30.9	35.7	46	24	48	29	R	1	14	19	25
TR02	W12	29-Jun-15	30.3	35.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W13	06-Jul-15	30.0	35.4	65	10	12	0	R	2	6	4	5
TR02	W14	13-Jul-15	30.4	35.7	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W15	20-Jul-15	30.5	35.7	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W16	27-Jul-15	30.6	35.8	65	16	16	1	43	0	28	1	6

NOTES:

Values presented for physical and chemical parameters are from field measurements obtained during sampling events.

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = Horizontal Treatment Train average flow rate

Flow V = Vertical Treatment Train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

NM = not measured

NTU = Nephelometric Turbidity Units

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

TR** = Test Run

VWTT = Vertical Wetland Treatment Train

W** = Week of Treatability Study Phase

¹ The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.

² The Aeration Cascade in the VWTT was bypassed on different occasions between 27 OCT 2014 and 16 NOV 2014. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in monthly reports for the VWTT prior to DEC 2014. The flow rates for the period 27 OCT 2014 - 16 NOV 2014 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the VWTT.

Table 11. ORP (millivolts)

Horizontal and Vertical Wetland Treatment Trains

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H ¹ (gpm)	FLOW V ^{1,2} (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	64	151	93	-428	-296	-305	49	-444	-275
C	W01	22-Sep-14	30.7	44.5	-16	R	24	-259	-346	-277	-38	-257	-243
C	W02	29-Sep-14	29.5	41.3	-17	33	-49	-266	-272	-245	23	-265	-230
C	W03	06-Oct-14	30.2	35.1	NM	46	-26	-218	-237	-225	25	-244	-207
C	W04	13-Oct-14	26.8	35.7	32	54	-20	-192	-162	-191	-58	-226	-182
C	W05	20-Oct-14	29.2	35.9	27	65	45	-148	-51	-90	22	-180	-146
C	W06	27-Oct-14	27.7	43.2	-24	41	36	-160	-40	-60	-86	-203	-100
C	W07	03-Nov-14	28.8	32.0	27	26	34	-108	57	20	-21	-170	45
C	W08	10-Nov-14	27.9	29.8	-10	2	-29	-161	-24	-21	-43	-184	3
C	W09	17-Nov-14	27.9	29.2	26	65	61	-179	-96	-40	19	-207	-126
C	W10	24-Nov-14	27.0	29.2	21	51	29	-129	-84	20	36	-205	106
C	W11	01-Dec-14	25.9	28.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W12	08-Dec-14	25.5	27.8	-26	16	19	-215	-116	-33	-49	-235	-138
C	W13	15-Dec-14	25.1	26.2	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W14	22-Dec-14	24.1	25.4	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W15	29-Dec-14	23.3	24.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W00	05-Jan-15	22.7	25.7	5	45	27	-230	-152	33	59	-256	-177
TR01	W01	12-Jan-15	21.6	27.3	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W02	19-Jan-15	20.4	25.9	1	50	-27	-225	-118	81	3	-232	-148
TR01	W03	26-Jan-15	21.9	30.8	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W04	02-Feb-15	27	32	-28	51	6	-232	-132	43	-17	-250	-158
TR01	W05	09-Feb-15	27.8	30.3	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W06	16-Feb-15	28.7	29.4	-25	37	-26	-227	-138	26	15	-221	-151
TR01	W07	23-Feb-15	28.7	25.2	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W08	02-Mar-15	28.2	24.9	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W09	09-Mar-15	29.3	28.1	-4	86	78	-231	-184	62	96	-225	-185
TR01	W10	16-Mar-15	29.5	29.7	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W11	23-Mar-15	34.9	36.4	33	77	81	-131	-112	51	73	-132	-108
TR01	W12	30-Mar-15	34.4	38.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W00	06-Apr-15	32.3	36	12	45	4	-224	-154	26	63	-235	-161
TR02	W01	13-Apr-15	38	39.8	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W02	20-Apr-15	36.7	39.3	-15	33	36	-179	-159	23	87	-248	-126
TR02	W03	27-Apr-15	36.1	39.3	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W04	04-May-15	35.2	39.1	-15	34	20	-213	-157	42	37	-243	-151
TR02	W05	11-May-15	33.4	37.8	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W06	18-May-15	32.0	36.6	78	135	124	-111	-121	85	125	-141	-124
TR02	W07	25-May-16	31.9	36.2	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W08	01-Jun-15	31.3	35.7	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W09	08-Jun-15	30.9	35.3	163	165	165	69	-70	27	170	-36	9
TR02	W10	15-Jun-15	30.8	35.6	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W11	22-Jun-15	30.9	35.7	138	140	115	93	50	153	147	-26	-57
TR02	W12	29-Jun-15	30.3	35.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W13	06-Jul-15	30.0	35.4	110	127	43	70	-90	105	122	-158	-104
TR02	W14	13-Jul-15	30.4	35.7	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W15	20-Jul-15	30.5	35.7	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W16	27-Jul-15	30.6	35.8	74	59	52	-21	-113	37	59	-192	-138

NOTES:

Values presented for physical and chemical parameters are from field measurements obtained during sampling events.

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = Horizontal Treatment Train average flow rate

Flow V = Vertical Treatment Train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

mV = millivolts

NM = not measured

ORP = Oxidation Reduction Potential

OU = operable unit

R = rejected

RDEFF = Rock Drain Effluent

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

TR** = Test Run

VWTT = Vertical Wetland Treatment Train

W** = Week of Treatability Study Phase

¹ The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.² The Aeration Cascade in the VWTT was bypassed on different occasions between 27 OCT 2014 and 16 NOV 2014. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in monthly reports for the VWTT prior to DEC 2014. The flow rates for the period 27 OCT 2014 - 16 NOV 2014 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the VWTT.

Table 12. Dissolved Oxygen (mg/L)

Horizontal and Vertical Wetland Treatment Trains

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H ¹ (gpm)	FLOW V ² (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	5.6	5.2	6.8	0.2	0.4	0.4	5.2	0.1	0.9
C	W01	22-Sep-14	30.7	44.5	6.6	2.1	6.1	0.9	0.1	1.7	3.5	1.8	3.1
C	W02	29-Sep-14	29.5	41.3	5.9	5.7	7	1.8	1.9	2.4	6.1	0.7	3.2
C	W03	06-Oct-14	30.2	35.1	NM	6.1	6.7	2.6	1.8	1.2	5.9	1.4	3
C	W04	13-Oct-14	26.8	35.7	6.1	6.4	7.2	3.1	3.7	1.8	5.9	1.5	2.9
C	W05	20-Oct-14	29.2	35.9	3.9	6.3	6	3.1	5.4	2.5	6.1	2.1	3.4
C	W06	27-Oct-14	27.7	43.2	6	6.2	6.1	3	6.2	2.3	6	2.5	4.3
C	W07	03-Nov-14	28.8	32.0	ns	6.4	7.3	3.4	6	3.7	6.7	3.1	5.1
C	W08	10-Nov-14	27.9	29.8	6.1	6.2	7	3.6	5.6	2.5	6	1.9	2.5
C	W09	17-Nov-14	27.9	29.2	5.5	6.2	7.3	0.3	5.2	0.2	5.6	0.5	2.8
C	W10	24-Nov-14	27.0	29.2	6	6.1	7.7	1.7	5.6	1.1	5.7	0.4	3.7
C	W11	01-Dec-14	25.9	28.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W12	08-Dec-14	25.5	27.8	5.7	6.2	7	1.7	6.1	2.6	5.9	1.8	3.6
C	W13	15-Dec-14	25.1	26.2	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W14	22-Dec-14	24.1	25.4	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W15	29-Dec-14	23.3	24.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W00	05-Jan-15	22.7	25.7	5.6	5.9	6.9	0.6	5.8	0.7	5.9	0.3	2.6
TR01	W01	12-Jan-15	21.6	27.3	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W02	19-Jan-15	20.4	25.9	5	6.5	6.9	0.4	5.9	0.8	5.6	0.3	2.5
TR01	W03	26-Jan-15	21.9	30.8	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W04	02-Feb-15	27.0	32.0	5.3	5.9	7	0.5	5.7	1.8	5.7	0.3	2.2
TR01	W05	09-Feb-15	27.8	30.3	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W06	16-Feb-15	28.7	29.4	5.3	5.9	7.4	0.5	6.1	2.6	6.7	0.6	2.6
TR01	W07	23-Feb-15	28.7	25.2	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W08	02-Mar-15	28.2	24.9	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W09	09-Mar-15	29.3	28.1	5.5	5.7	6.8	0.7	6.2	1.3	5.6	0.4	2.9
TR01	W10	16-Mar-15	29.5	29.7	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W11	23-Mar-15	34.9	36.4	5.5	5.9	6.5	0.7	5.3	1.4	5.5	0.2	2.4
TR01	W12	30-Mar-15	34.4	38.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W00	06-Apr-15	32.3	36	5.5	5.4	6.7	0.5	5.4	0.8	5	0.1	2.9
TR02	W01	13-Apr-15	38	39.8	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W02	20-Apr-15	36.7	39.3	5.5	6.1	6.4	0.4	5	0.4	5.7	R	3.2
TR02	W03	27-Apr-15	36.1	39.3	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W04	04-May-15	35.2	39.1	5.5	5.6	6.4	0.4	4.5	0.9	5.4	0.3	3.9
TR02	W05	11-May-15	33.4	37.8	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W06	18-May-15	32.0	36.6	5.6	5.6	6.6	0.4	5.5	0.8	5.7	0.4	4.5
TR02	W07	25-May-16	31.9	36.2	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W08	01-Jun-15	31.3	35.7	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W09	08-Jun-15	30.9	35.3	5.7	5.6	6.2	1.9	6.8	1.1	5.7	0.1	5.4
TR02	W10	15-Jun-15	30.8	35.6	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W11	22-Jun-15	30.9	35.7	5.9	6.1	6.2	0.7	5.9	0.3	6	0.1	4.8
TR02	W12	29-Jun-15	30.3	35.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W13	06-Jul-15	30.0	35.4	5.9	6	6.6	1.1	5.8	8.1	6.2	0.2	5.2
TR02	W14	13-Jul-15	30.4	35.7	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W15	20-Jul-15	30.5	35.7	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W16	27-Jul-15	30.6	35.8	6.1	5.9	6.6	0.5	5.6	0.6	6.4	0.1	4.9

NOTES:

Values presented for physical and chemical parameters are from field measurements obtained during sampling events.

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = Horizontal Treatment Train average flow rate

Flow V = Vertical Treatment Train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

mg/L = milligram per liter

NM = not measured

OU = operable unit

RDEFF = Rock Drain Effluent

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

TR** = Test Run

VWTT = Vertical Wetland Treatment Train

W** = Week of Treatability Study Phase

¹ The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.² The Aeration Cascade in the VWTT was bypassed on different occasions between 27 OCT 2014 and 16 NOV 2014. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in monthly reports for the VWTT prior to DEC 2014. The flow rates for the period 27 OCT 2014 - 16 NOV 2014 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the VWTT.

Table 13. Temperature (degrees Celsius)

Horizontal and Vertical Wetland Treatment Trains

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	FLOW H ¹ (gpm)	FLOW V ^{1,2} (gpm)	FDB	SB1EFF	SFWEFF	HSSFWMP11	AC1EFF	RDEFF	SB2EFF	BTEFF	AC2EFF
C	W00	15-Sep-14	25.8	33.8	18.8	18.1	18.8	14.7	16.2	12.9	18.6	18.8	16.4
C	W01	22-Sep-14	30.7	44.5	20.1	19.1	19.3	17.9	19.1	17.2	19.2	18.3	18
C	W02	29-Sep-14	29.5	41.3	16.8	15.5	16.4	14.4	13.2	12.1	15.3	13.5	13.2
C	W03	06-Oct-14	30.2	35.1	NM	15.9	14	13.2	13.3	12.5	15.5	15.3	15.3
C	W04	13-Oct-14	26.8	35.7	18.7	17.4	18.3	15.5	15.5	18	17.5	17.5	19.4
C	W05	20-Oct-14	29.2	35.9	19.6	17.7	18.2	17.1	15.3	15.2	18	18.3	17.3
C	W06	27-Oct-14	27.7	43.2	18.8	17.7	17.5	15.3	15.4	12.1	18.3	17.3	17.5
C	W07	03-Nov-14	28.8	32.0	19.1	17.7	18.1	14.1	14.8	12.4	16.5	16.5	15.7
C	W08	10-Nov-14	27.9	29.8	15.7	15.9	15.7	13.3	13.1	11.3	15.1	14.7	14.9
C	W09	17-Nov-14	27.9	29.2	18.7	14.9	12.1	11.7	10.5	9.8	16.8	14.7	14.4
C	W10	24-Nov-14	27.0	29.2	18.1	16.3	12.9	5.7	8.4	9.1	15.6	15.1	14.1
C	W11	01-Dec-14	25.9	28.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W12	08-Dec-14	25.5	27.8	17.6	14.4	13	12.7	9.6	10.4	15.2	14.7	15.1
C	W13	15-Dec-14	25.1	26.2	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W14	22-Dec-14	24.1	25.4	NM	NM	NM	NM	NM	NM	NM	NM	NM
C	W15	29-Dec-14	23.3	24.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W00	05-Jan-15	22.7	25.7	19.2	16.1	15.5	12.1	10.9	8.9	16.7	15	13.6
TR01	W01	12-Jan-15	21.6	27.3	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W02	19-Jan-15	20.4	25.9	18.9	14.5	13.2	10.6	9.2	7.9	15.1	14.9	14.4
TR01	W03	26-Jan-15	21.9	30.8	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W04	02-Feb-15	27.0	32.0	19.2	16.4	16.2	12.5	11.4	9.1	16.3	15.9	15.4
TR01	W05	09-Feb-15	27.8	30.3	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W06	16-Feb-15	28.7	29.4	19.2	15.9	16	11.1	10	8.3	14.7	14.4	13.8
TR01	W07	23-Feb-15	28.7	25.2	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W08	02-Mar-15	28.2	24.9	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W09	09-Mar-15	29.3	28.1	19.3	16.9	16.7	13.3	12.2	10.5	15.6	14.9	14
TR01	W10	16-Mar-15	29.5	29.7	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR01	W11	23-Mar-15	34.9	36.4	18.6	16.8	16.1	14.1	13.2	12.1	16.2	15.8	15.1
TR01	W12	30-Mar-15	34.4	38.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W00	06-Apr-15	32.3	36	18.7	17.3	17.7	14.3	14.3	12.2	16	16.1	15.5
TR02	W01	13-Apr-15	38	39.8	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W02	20-Apr-15	36.7	39.3	19.3	19.4	20.6	15.5	15.7	13.1	17.4	17.1	16.2
TR02	W03	27-Apr-15	36.1	39.3	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W04	04-May-15	35.2	39.1	19.2	18.4	17.7	16	16.1	13.3	17.9	16.6	16.6
TR02	W05	11-May-15	33.4	37.8	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W06	18-May-15	32.0	36.6	19	19.1	20	16	15.8	13.7	17.1	16.9	16.5
TR02	W07	25-May-16	31.9	36.2	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W08	01-Jun-15	31.3	35.7	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W09	08-Jun-15	30.9	35.3	18.8	18.7	19.2	16.3	16.5	15.7	18.4	17.5	17.3
TR02	W10	15-Jun-15	30.8	35.6	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W11	22-Jun-15	30.9	35.7	19.5	20	21.6	18.6	18.7	17.3	18	18.1	18
TR02	W12	29-Jun-15	30.3	35.5	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W13	06-Jul-15	30.0	35.4	18.7	18.5	17.6	16.8	17	15.8	17.5	17.3	17.5
TR02	W14	13-Jul-15	30.4	35.7	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W15	20-Jul-15	30.5	35.7	NM	NM	NM	NM	NM	NM	NM	NM	NM
TR02	W16	27-Jul-15	30.6	35.8	19	19.5	21.9	17	18.1	16.5	17.8	17.6	17.6

NOTES:

Values presented for physical and chemical parameters are from field measurements obtained during sampling events.

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

DEG C = degrees celsius

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

Flow H = Horizontal Treatment Train average flow rate

Flow V = Vertical Treatment Train average flow rate

gpm = gallons per minute

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

NM = not measured

OU = operable unit

RDEFF = Rock Drain Effluent

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

TR** = Test Run

VWTT = Vertical Wetland Treatment Train

W** = Week of Treatability Study Phase

¹ The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.² The Aeration Cascade in the VWTT was bypassed on different occasions between 27 OCT 2014 and 16 NOV 2014. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in monthly reports for the VWTT prior to DEC 2014. The flow rates for the period 27 OCT 2014 - 16 NOV 2014 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the VWTT.

Table 14. Mass Removal

Horizontal and Vertical Wetland Treatment Trains

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	Analyte Name	FDB (µg/L)	RDEFF (µg/L)	H Δ CONC (µg/L)	H FLOW (gpm)	H FLOW TOTAL (gallons)	H REMOVAL EFFICIENCY (%)	H MASS REMOVAL RATE (g/day)	AC2EFF (µg/L)	V Δ CONC (µg/L)	V FLOW (gpm)	V FLOW TOTAL (gallons)	V REMOVAL EFFICIENCY (%)	V MASS REMOVAL RATE (g/day)
C	W00	15-Sep-14	Cadmium, Dissolved	19.6	<0.5	19.6	25.8	259,600	100	2.8	<0.5	19.6	33.8	340200	100	3.6
C	W01	22-Sep-14	Cadmium, Dissolved	20.2	<0.5	20.2	30.7	309,600	100	3.4	<0.5	20.2	44.5	448200	100	4.9
C	W02	29-Sep-14	Cadmium, Dissolved	22.5	<0.5	22.5	29.5	297,200	100	3.6	<0.5	22.5	41.3	416100	100	5.1
C	W03	06-Oct-14	Cadmium, Dissolved	22.3	<0.5	22.3	30.2	304,500	100	3.7	<0.5	22.3	35.1	353800	100	4.3
C	W04	13-Oct-14	Cadmium, Dissolved	23	<0.5	23	26.8	270,000	100	3.4	<0.5	23	35.7	359700	100	4.5
C	W05	20-Oct-14	Cadmium, Dissolved	23.4	<0.5	23.4	29.2	294,600	100	3.7	<0.5	23.4	35.9	361600	100	4.6
C	W06	27-Oct-14	Cadmium, Dissolved	22.7	<0.5	22.7	27.7	278,800	100	3.4	<0.5	22.7	43.2	435500	100	5.3
C	W07	03-Nov-14	Cadmium, Dissolved	20.4	<0.5	20.4	28.8	290,300	100	3.2	<0.5	20.4	32	322600	100	3.6
C	W08	10-Nov-14	Cadmium, Dissolved	22.6	<0.5	22.6	27.9	280,900	100	3.4	<0.5	22.6	29.8	300300	100	3.7
C	W09	17-Nov-14	Cadmium, Dissolved	21.4	<0.5	21.4	27.9	281,100	100	3.3	<0.5	21.4	29.2	294300	100	3.4
C	W10	24-Nov-14	Cadmium, Dissolved	20.2	<0.5	20.2	27.0	271,700	100	3	<0.5	20.2	29.2	294300	100	3.2
C	W11	01-Dec-14	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	Cadmium, Dissolved	21.5	<0.5	21.5	25.5	257,200	100	3	<0.5	21.5	27.8	279900	100	3.3
C	W13	15-Dec-14	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W14	22-Dec-14	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W15	29-Dec-14	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W00	05-Jan-15	Cadmium, Dissolved	19.1	<0.5	19.1	22.7	228,700	100	2.4	<0.5	19.1	25.7	259200	100	2.7
TR01	W01	12-Jan-15	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W02	19-Jan-15	Cadmium, Dissolved	18.6	<0.5	18.6	20.4	206,100	100	2.1	<0.5	18.6	25.9	261400	100	2.6
TR01	W03	26-Jan-15	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W04	02-Feb-15	Cadmium, Dissolved	18.3	<0.5	18.3	27.0	272,600	100	2.7	<0.5	18.3	32	322200	100	3.2
TR01	W05	09-Feb-15	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W06	16-Feb-15	Cadmium, Dissolved	19.4	<0.5	19.4	28.6	288,400	100	3	<0.5	19.4	29.3	295600	100	3.1
TR01	W07	23-Feb-15	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W08	02-Mar-15	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W09	09-Mar-15	Cadmium, Dissolved	18.7	<0.5	18.7	29.3	295,000	100	3	<0.5	18.7	28.1	283300	100	2.9
TR01	W10	16-Mar-15	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W11	23-Mar-15	Cadmium, Dissolved	23.7	<0.5	23.7	34.9	352,200	100	4.5	<0.5	23.7	36.4	367300	100	4.7
TR01	W12	30-Mar-15	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W00	06-Apr-15	Cadmium, Dissolved	18.7	<0.5	18.7	32.3	325,100	100	3.3	<0.5	18.7	36	362700	100	3.7
TR02	W01	13-Apr-15	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W02	20-Apr-15	Cadmium, Dissolved	16.3	<0.5	16.3	36.7	369,600	100	3.3	<0.5	16.3	39.3	395800	100	3.5
TR02	W03	27-Apr-15	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W04	04-May-15	Cadmium, Dissolved	18.9	<0.5	18.9	35.2	355,100	100	3.6	<0.5	18.9	39.1	393700	100	4
TR02	W05	11-May-15	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W06	18-May-15	Cadmium, Dissolved	79.1	<0.5	79.1	32.0	322800	100	13.8	<0.5	79.1	36.6	368600	100	15.8
TR02	W07	25-May-16	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W08	01-Jun-15	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W09	08-Jun-15	Cadmium, Dissolved	76.2	<0.5	76.2	31.2	314000	100	13	<0.5	76.2	35.6	358800	100	14.8
TR02	W10	15-Jun-15	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W11	22-Jun-15	Cadmium, Dissolved	61.2	<0.5	61.2	30.9	311300	100	10.3	<0.5	61.2	35.7	360300	100	11.9
TR02	W12	29-Jun-15	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W13	06-Jul-15	Cadmium, Dissolved	41.4	<0.5	41.4	30.0	302800	100	6.8	<0.5	41.4	35.4	357000	100	8
TR02	W14	13-Jul-15	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W15	20-Jul-15	Cadmium, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W16	27-Jul-15	Cadmium, Dissolved	32	<0.08	32	30.625	308700	100	5.3	<0.08	32	35.8	361000	100	6.2

Table 14. Mass Removal

Horizontal and Vertical Wetland Treatment Trains

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	Analyte Name	FDB (µg/L)	RDEFF (µg/L)	H Δ CONC (µg/L)	H FLOW (gpm)	H FLOW TOTAL (gallons)	H REMOVAL EFFICIENCY (%)	H MASS REMOVAL RATE (g/day)	AC2EFF (µg/L)	V Δ CONC (µg/L)	V FLOW (gpm)	V FLOW TOTAL (gallons)	V REMOVAL EFFICIENCY (%)	V MASS REMOVAL RATE (g/day)
C	W00	15-Sep-14	Iron	4500	250	4250	25.8	259,600	94.4	597.7	246	4254	33.8	340200	94.5	783.8
C	W01	22-Sep-14	Iron	3740	170	3570	30.7	309,600	95.5	597.4	218	3522	44.5	448200	94.2	854.3
C	W02	29-Sep-14	Iron	4230	129	4101	29.5	297,200	97	659.5	210	4020	41.3	416100	95	905
C	W03	06-Oct-14	Iron	3940	134	3806	30.2	304,500	96.6	626.5	165	3775	35.1	353800	95.8	722.3
C	W04	13-Oct-14	Iron	3820	144	3676	26.8	270,000	96.2	537	154	3666	35.7	359700	96	713.4
C	W05	20-Oct-14	Iron	5730	326	5404	29.2	294,600	94.3	860.1	143	5587	35.9	361600	97.5	1093.3
C	W06	27-Oct-14	Iron	24100	1340	22760	27.7	278,800	94.4	3436.6	137	23963	43.2	435500	99.4	5642.9
C	W07	03-Nov-14	Iron	4550	297	4253	28.8	290,300	93.5	667.7	153	4397	32	322600	96.6	767
C	W08	10-Nov-14	Iron	5720	99.6	5620.4	27.9	280,900	98.3	854.8	148	5572	29.8	300300	97.4	905.1
C	W09	17-Nov-14	Iron	8800	141	8659	27.9	281,100	98.4	1316.9	260	8540	29.2	294300	97	1359.3
C	W10	24-Nov-14	Iron	5230	<50	5230	27.0	271,700	100	769.7	245	4985	29.2	294300	95.3	793.5
C	W11	01-Dec-14	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	Iron	5710	<50	5710	25.5	257,200	100	793.7	156	5554	27.8	279900	97.3	841.6
C	W13	15-Dec-14	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W14	22-Dec-14	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W15	29-Dec-14	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W00	05-Jan-15	Iron	6130	<50	6130	22.7	228,700	100	758.5	131	5999	25.7	259200	97.9	840.4
TR01	W01	12-Jan-15	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W02	19-Jan-15	Iron	7510	<50	7510	20.4	206,100	100	835.1	109	7401	25.9	261400	98.5	1044.9
TR01	W03	26-Jan-15	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W04	02-Feb-15	Iron	7980	<50	7980	27.0	272,600	100	1174.5	162	7818	32	322200	98	1363.7
TR01	W05	09-Feb-15	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W06	16-Feb-15	Iron	9530	<50	9530	28.6	288,400	100	1485.7	142	9388	29.3	295600	98.5	1499.4
TR01	W07	23-Feb-15	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W08	02-Mar-15	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W09	09-Mar-15	Iron	10400	<50	10400	29.3	295,000	100	1661	138	10262	28.1	283300	98.7	1571.9
TR01	W10	16-Mar-15	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W11	23-Mar-15	Iron	8450	<50	8450	34.9	352,200	100	1607.5	291	8159	36.4	367300	96.6	1618.9
TR01	W12	30-Mar-15	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W00	06-Apr-15	Iron	9260	<50	9260	32.3	325,100	100	1630.4	202	9058	36	362700	97.8	1777.5
TR02	W01	13-Apr-15	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W02	20-Apr-15	Iron	9020	<50	9020	36.7	369,600	100	1804.5	261	8759	39.3	395800	97.1	1876.4
TR02	W03	27-Apr-15	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W04	04-May-15	Iron	8630	75.8	8554.2	35.2	355,100	99.1	1642.6	210	8420	39.1	393700	97.6	1794.6
TR02	W05	11-May-15	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W06	18-May-15	Iron	5460	<50	5460	32.0	322800	100	953.1	425	5035	36.6	368600	92.2	1004.5
TR02	W07	25-May-16	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W08	01-Jun-15	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W09	08-Jun-15	Iron	4150	68.8	4081.2	31.2	314000	98.3	694.1	905	3245	35.6	358800	78.2	629.6
TR02	W10	15-Jun-15	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W11	22-Jun-15	Iron	2990	106	2884	30.9	311300	96.5	485.8	570	2420	35.7	360300	80.9	470.9
TR02	W12	29-Jun-15	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W13	06-Jul-15	Iron	3860	53.9	3806.1	30.0	302800	98.6	623.2	323	3537	35.4	357000	91.6	682.8
TR02	W14	13-Jul-15	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W15	20-Jul-15	Iron	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W16	27-Jul-15	Iron	4480	<50	4480	30.625	308700	100	747.9	224	4256	35.8	361000	95	830.8

Table 14. Mass Removal

Horizontal and Vertical Wetland Treatment Trains

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	Analyte Name	FDB (µg/L)	RDEFF (µg/L)	H Δ CONC (µg/L)	H FLOW (gpm)	H FLOW TOTAL (gallons)	H REMOVAL EFFICIENCY (%)	H MASS REMOVAL RATE (g/day)	AC2EFF (µg/L)	V Δ CONC (µg/L)	V FLOW (gpm)	V FLOW TOTAL (gallons)	V REMOVAL EFFICIENCY (%)	V MASS REMOVAL RATE (g/day)
C	W00	15-Sep-14	Iron, Dissolved	772	76.2	695.8	25.8	259,600	90.1	97.9	174	598	33.8	340200	77.5	110.2
C	W01	22-Sep-14	Iron, Dissolved	723	<50	723	30.7	309,600	100	121	128	595	44.5	448200	82.3	144.3
C	W02	29-Sep-14	Iron, Dissolved	1320	<50	1320	29.5	297,200	100	212.3	147	1173	41.3	416100	88.9	264.1
C	W03	06-Oct-14	Iron, Dissolved	625	53.3	571.7	30.2	304,500	91.5	94.1	86.2	538.8	35.1	353800	86.2	103.1
C	W04	13-Oct-14	Iron, Dissolved	339	66.1	272.9	26.8	270,000	80.5	39.9	89.4	249.6	35.7	359700	73.6	48.6
C	W05	20-Oct-14	Iron, Dissolved	575	195	380	29.2	294,600	66.1	60.5	106	469	35.9	361600	81.6	91.8
C	W06	27-Oct-14	Iron, Dissolved	1930	847	1083	27.7	278,800	56.1	163.5	113	1817	43.2	435500	94.1	427.9
C	W07	03-Nov-14	Iron, Dissolved	483	148	335	28.8	290,300	69.4	52.6	106	377	32	322600	78.1	65.8
C	W07	03-Nov-14	Iron, Dissolved	2290	79.8	2210.2	27.9	280,900	96.5	336.1	90	2200	29.8	300300	96.1	357.4
C	W09	17-Nov-14	Iron, Dissolved	1140	111	1029	27.9	281,100	90.3	156.5	188	952	29.2	294300	83.5	151.5
C	W10	24-Nov-14	Iron, Dissolved	3480	<50	3480	27.0	271,700	100	512.2	163	3317	29.2	294300	95.3	528
C	W11	01-Dec-14	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	Iron, Dissolved	5510	<50	5510	25.5	257,200	100	765.9	161	5349	27.8	279900	97.1	810.6
C	W13	15-Dec-14	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W14	22-Dec-14	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W15	29-Dec-14	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W00	05-Jan-15	Iron, Dissolved	1060	<50	1060	22.7	228,700	100	131.2	148	912	25.7	259200	86	127.8
TR01	W01	12-Jan-15	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W02	19-Jan-15	Iron, Dissolved	2050	<50	2050	20.4	206,100	100	228	95.6	1954.4	25.9	261400	95.3	275.9
TR01	W03	26-Jan-15	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W04	02-Feb-15	Iron, Dissolved	2260	<50	2260	27.0	272,600	100	332.6	148	2112	32	322200	93.5	368.4
TR01	W05	09-Feb-15	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W06	16-Feb-15	Iron, Dissolved	2580	<50	2580	28.6	288,400	100	402.2	124	2456	29.3	295600	95.2	392.3
TR01	W07	23-Feb-15	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W08	02-Mar-15	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W09	09-Mar-15	Iron, Dissolved	1600	<50	1600	29.3	295000	100	255.5	118	1482	28.1	283300	92.6	227
TR01	W10	16-Mar-15	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W11	23-Mar-15	Iron, Dissolved	2290	<50	2290	34.9	352,200	100	435.6	289	2001	36.4	367300	87.4	397
TR01	W12	30-Mar-15	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W00	06-Apr-15	Iron, Dissolved	2610	<50	2610	32.3	325100	100	459.5	187	2423	36	362700	92.8	475.5
TR02	W01	13-Apr-15	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W02	20-Apr-15	Iron, Dissolved	2810	59.9	2750.1	36.7	369,600	97.9	550.2	213	2597	39.3	395800	92.4	556.3
TR02	W03	27-Apr-15	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W04	04-May-15	Iron, Dissolved	2220	52.2	2167.8	35.2	355,100	97.6	416.3	179	2041	39.1	393700	91.9	435
TR02	W05	11-May-15	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W06	18-May-15	Iron, Dissolved	1440	<50	1440	32.0	322800	100	251.4	436	1004	36.6	368600	69.7	200.3
TR02	W07	25-May-16	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W08	01-Jun-15	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W09	08-Jun-15	Iron, Dissolved	1510	<50	1510	31.2	314000	100	256.8	794	716	35.6	358800	47.4	138.9
TR02	W10	15-Jun-15	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W11	22-Jun-15	Iron, Dissolved	544	<50	544	30.9	311300	100	91.6	371	173	35.7	360300	31.8	33.7
TR02	W12	29-Jun-15	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W13	06-Jul-15	Iron, Dissolved	389	<50	389	30.0	302800	100	63.7	300	89	35.4	357000	22.9	17.2
TR02	W14	13-Jul-15	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W15	20-Jul-15	Iron, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W16	27-Jul-15	Iron, Dissolved	206	<50	206	30.625	308700	100	34.4	181	25	35.8	361000	12.1	4.9

Table 14. Mass Removal

Horizontal and Vertical Wetland Treatment Trains

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	Analyte Name	FDB (µg/L)	RDEFF (µg/L)	H Δ CONC (µg/L)	H FLOW (gpm)	H FLOW TOTAL (gallons)	H REMOVAL EFFICIENCY (%)	H MASS REMOVAL RATE (g/day)	AC2EFF (µg/L)	V Δ CONC (µg/L)	V FLOW (gpm)	V FLOW TOTAL (gallons)	V REMOVAL EFFICIENCY (%)	V MASS REMOVAL RATE (g/day)
C	W00	15-Sep-14	Manganese, Dissolved	2080	1760	320	25.8	259,600	15.4	45	1700	380	33.8	340200	18.3	70
C	W01	22-Sep-14	Manganese, Dissolved	2160 J	1620	540	30.7	309,600	25	90.4	1970	190	44.5	448200	8.8	46.1
C	W02	29-Sep-14	Manganese, Dissolved	2200	1500	700	29.5	297,200	31.8	112.6	2110	90	41.3	416100	4.1	20.3
C	W03	06-Oct-14	Manganese, Dissolved	2260	1750 J	510	30.2	304,500	22.6	84	2160	100	35.1	353800	4.4	19.1
C	W04	13-Oct-14	Manganese, Dissolved	2310 B	1970 B	340	26.8	270,000	14.7	49.7	2040 B	270	35.7	359700	11.7	52.5
C	W05	20-Oct-14	Manganese, Dissolved	2270	2030	240	29.2	294,600	10.6	38.2	1820	450	35.9	361600	19.8	88.1
C	W06	27-Oct-14	Manganese, Dissolved	2220	1650 J	570	27.7	278,800	25.7	86.1	1520	700	43.2	435500	31.5	164.8
C	W07	03-Nov-14	Manganese, Dissolved	2250	594	1656	28.8	290,300	73.6	260	1750 J	500	32	322600	22.2	87.2
C	W08	10-Nov-14	Manganese, Dissolved	2400	293	2107	27.9	280,900	87.8	320.4	1750	650	29.8	300300	27.1	105.6
C	W09	17-Nov-14	Manganese, Dissolved	2260	396	1864	27.9	281,100	82.5	283.5	1680	580	29.2	294300	25.7	92.3
C	W10	24-Nov-14	Manganese, Dissolved	2180	106	2074	27.0	271,700	95.1	305.2	1340	840	29.2	294300	38.5	133.7
C	W11	01-Dec-14	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	Manganese, Dissolved	2200	232	1968	25.5	257,200	89.5	273.6	571	1629	27.8	279900	74	246.9
C	W13	15-Dec-14	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W14	22-Dec-14	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W15	29-Dec-14	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W00	05-Jan-15	Manganese, Dissolved	2150	141	2009	22.7	228,700	93.4	248.6	520	1630	25.7	259200	75.8	228.3
TR01	W01	12-Jan-15	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W02	19-Jan-15	Manganese, Dissolved	2070	190	1880	20.4	206,100	90.8	209.1	618	1452	25.9	261400	70.1	205
TR01	W03	26-Jan-15	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W04	02-Feb-15	Manganese, Dissolved	2070	654	1416	27.0	272,600	68.4	208.4	1270	800	32	322200	38.6	139.5
TR01	W05	09-Feb-15	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W06	16-Feb-15	Manganese, Dissolved	2100	721	1379	28.6	288,400	65.7	215	521	1579	29.3	295600	75.2	252.2
TR01	W07	23-Feb-15	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W08	02-Mar-15	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W09	09-Mar-15	Manganese, Dissolved	2090	641	1449	29.3	295,000	69.3	231.4	500	1590	28.1	283300	76.1	243.5
TR01	W10	16-Mar-15	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W11	23-Mar-15	Manganese, Dissolved	2070	1020	1050	34.9	352,200	50.7	199.8	558	1512	36.4	367300	73	300
TR01	W12	30-Mar-15	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W00	06-Apr-15	Manganese, Dissolved	1870 B	913 B	957	32.3	325,100	51.2	168.5	1040 B	830	36	362700	44.4	162.9
TR02	W01	13-Apr-15	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W02	20-Apr-15	Manganese, Dissolved	1840	732 J	1108	36.7	369,600	60.2	221.7	844 J	996	39.3	395800	54.1	213.4
TR02	W03	27-Apr-15	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W04	04-May-15	Manganese, Dissolved	1910	949	961	35.2	355,100	50.3	184.5	689	1221	39.1	393700	63.9	260.2
TR02	W05	11-May-15	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W06	18-May-15	Manganese, Dissolved	4260	387	3873	32.0	322800	90.9	676.1	1080	3180	36.6	368600	74.6	634.4
TR02	W07	25-May-16	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W08	01-Jun-15	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W09	08-Jun-15	Manganese, Dissolved	3970	69.8	3900.2	31.2	314000	98.2	663.3	3730	240	35.6	358800	6	46.6
TR02	W10	15-Jun-15	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W11	22-Jun-15	Manganese, Dissolved	3440 B	37.9 B	3402.1	30.9	311300	98.9	573	4210 B	-770	35.7	360300	-22.4	-149.8
TR02	W12	29-Jun-15	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W13	06-Jul-15	Manganese, Dissolved	3350	328	3022	30.0	302800	90.2	494.8	3810	-460	35.4	357000	-13.7	-88.8
TR02	W14	13-Jul-15	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W15	20-Jul-15	Manganese, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W16	27-Jul-15	Manganese, Dissolved	2860	736	2124	30.625	308700	74.3	354.6	1540	1320	35.8	361000	46.2	257.7

Table 14. Mass Removal

Horizontal and Vertical Wetland Treatment Trains

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	Analyte Name	FDB (µg/L)	RDEFF (µg/L)	H Δ CONC (µg/L)	H FLOW (gpm)	H FLOW TOTAL (gallons)	H REMOVAL EFFICIENCY (%)	H MASS REMOVAL RATE (g/day)	AC1EFF (µg/L)	V Δ CONC (µg/L)	V FLOW (gpm)	V FLOW TOTAL (gallons)	V REMOVAL EFFICIENCY (%)	V MASS REMOVAL RATE (g/day)
C	W00	15-Sep-14	Zinc, Dissolved	3500	62.5	3437.5	25.8	259,600	98.2	483.4	148	3352	33.8	340200	95.8	617.6
C	W01	22-Sep-14	Zinc, Dissolved	3800 J	30	3770	30.7	309,600	99.2	630.9	<10	3800	44.5	448200	100	921.8
C	W02	29-Sep-14	Zinc, Dissolved	4000	<10	4000	29.5	297,200	100	643.2	279	3721	41.3	416100	93	837.7
C	W03	06-Oct-14	Zinc, Dissolved	3970	102	3868	30.2	304,500	97.4	636.7	<10	3970	35.1	353800	100	759.6
C	W04	13-Oct-14	Zinc, Dissolved	4000	53	3947	26.8	270,000	98.7	576.6	59.4	3940.6	35.7	359700	98.5	766.8
C	W05	20-Oct-14	Zinc, Dissolved	4160	69.3	4090.7	29.2	294,600	98.3	651.1	65.7	4094.3	35.9	361600	98.4	801.2
C	W06	27-Oct-14	Zinc, Dissolved	4120	47.9	4072.1	27.7	278,800	98.8	614.9	46.9	4073.1	43.2	435500	98.9	959.1
C	W07	03-Nov-14	Zinc, Dissolved	3790	54	3736	28.8	290,300	98.6	586.5	91.7	3698.3	32	322600	97.6	645.1
C	W08	10-Nov-14	Zinc, Dissolved	4230	<10	4230	27.9	280,900	100	643.3	49.4	4180.6	29.8	300300	98.8	679.1
C	W09	17-Nov-14	Zinc, Dissolved	3770	23.5	3746.5	27.9	281,100	99.4	569.8	48.8	3721.2	29.2	294300	98.7	592.3
C	W10	24-Nov-14	Zinc, Dissolved	3760	159	3601	27.0	271,700	95.8	530	54.5	3705.5	29.2	294300	98.6	589.8
C	W11	01-Dec-14	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W12	08-Dec-14	Zinc, Dissolved	3900	106	3794	25.5	257200	97.3	527.4	368	3532	27.8	279900	90.6	535.2
C	W13	15-Dec-14	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W14	22-Dec-14	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C	W15	29-Dec-14	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W00	05-Jan-15	Zinc, Dissolved	3470	38.3	3431.7	22.7	228700	98.9	424.6	26.1	3443.9	25.7	259200	99.2	482.5
TR01	W01	12-Jan-15	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W02	19-Jan-15	Zinc, Dissolved	3610	42.7	3567.3	20.4	206100	98.8	396.7	25.3	3584.7	25.9	261400	99.3	506.1
TR01	W03	26-Jan-15	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W04	02-Feb-15	Zinc, Dissolved	3520	52.9	3467.1	27	272600	98.5	510.3	63.7	3456.3	32	322200	98.2	602.9
TR01	W05	09-Feb-15	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W06	16-Feb-15	Zinc, Dissolved	3740	48.5	3691.5	28.6	288400	98.7	575.5	38.4	3701.6	29.3	295600	99	591.2
TR01	W07	23-Feb-15	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W08	02-Mar-15	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W09	09-Mar-15	Zinc, Dissolved	3290	57.1	3232.9	29.3	295000	98.3	516.3	16.7	3273.3	28.1	283300	99.5	501.4
TR01	W10	16-Mar-15	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR01	W11	23-Mar-15	Zinc, Dissolved	4270	52.4	4217.6	34.9	352,200	98.8	802.4	24.2	4245.8	36.4	367300	99.4	842.4
TR01	W12	30-Mar-15	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W00	06-Apr-15	Zinc, Dissolved	3540	44	3496	32.3	325100	98.8	615.5	12.7	3527.3	36	362700	99.6	692.2
TR02	W01	13-Apr-15	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W02	20-Apr-15	Zinc, Dissolved	3060	38.2	3021.8	36.7	369,600	98.8	604.5	10.7	3049.3	39.3	395800	99.7	653.2
TR02	W03	27-Apr-15	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W04	04-May-15	Zinc, Dissolved	3490	62.2	3427.8	35.2	355,100	98.2	658.2	34.7	3455.3	39.1	393700	99	736.4
TR02	W05	11-May-15	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W06	18-May-15	Zinc, Dissolved	13400	31.6	13368.4	32.0	322800	99.8	2333.6	225	13175	36.6	368600	98.3	2628.5
TR02	W07	25-May-16	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W08	01-Jun-15	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W09	08-Jun-15	Zinc, Dissolved	12300	187	12113	31.2	314000	98.5	2060.1	1090	11210	35.6	358800	91.1	2175.1
TR02	W10	15-Jun-15	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W11	22-Jun-15	Zinc, Dissolved	10500	393	10107	30.9	311300	96.3	1702.4	54	10446	35.7	360300	99.5	2032.8
TR02	W12	29-Jun-15	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W13	06-Jul-15	Zinc, Dissolved	6750	408	6342	30.0	302800	94	1038.5	854	5896	35.4	357000	87.3	1138.3
TR02	W14	13-Jul-15	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W15	20-Jul-15	Zinc, Dissolved	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TR02	W16	27-Jul-15	Zinc, Dissolved	5820	236	5584	30.625	308700	95.9	932.2	38.2	5781.8	35.8	361000	99.3	1128.7

NOTES:

Non-detects are reported as <RL and estimated as zero for calculations and graphing.

% = percent

AC1EFF = Aeration Channel Effluent/Rock Drain Influent

AC2EFF = Aeration Cascade Effluent

Table 14. Mass Removal

Horizontal and Vertical Wetland Treatment Trains

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	Analyte Name	FDB (µg/L)	RDEFF (µg/L)	H Δ CONC (µg/L)	H FLOW (gpm)	H FLOW TOTAL (gallons)	H REMOVAL EFFICIENCY (%)	H MASS REMOVAL RATE (g/day)	AC2EFF (µg/L)	V Δ CONC (µg/L)	V FLOW (gpm)	V FLOW TOTAL (gallons)	V REMOVAL EFFICIENCY (%)	V MASS REMOVAL RATE (g/day)
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B = Analyte is detected in an associated blank

BTEFF = Biotreatment Cell Effluent/Aeration Cascade Influent

C = Colonization

FDB = Flow Diversion Box (Settling Basin No. 1 Influent/Settling Basin No. 2 Influent)

g/day = grams per day

gpm = gallons per minute

H = horizontal

H Δ CONC = horizontal change in concentration

HSSFWMP11 = Horizontal Sub Surface Flow Wetland Effluent/Aeration Channel Influent

J = Estimated result

MDL = method detection limit

NS = not sampled

OU = operable unit

ppm = parts per million

RDEFF = Rock Drain Effluent

RL = reporting limit

SB1EFF = Settling Basin No. 1 Effluent/Surface Flow Wetland Influent

SB2EFF = Settling Basin No. 2 Effluent/Biotreatment Cell Influent

SFWEFF = Surface Flow Wetland Effluent/Horizontal Sub Surface Flow Wetland Influent

TR** = Test Run

V = vertical

V Δ CONC = vertical change in concentration

VWTT = Vertical Wetland Treatment Train

W** = Week of Treatability Study Phase

The interpolation method for calculating weekly flow totals for both the horizontal and vertical treatment trains was modified to improve precision.

The Aeration Cascade in the VWTT was bypassed on different occasions between 27 OCT 2014 and 16 NOV 2014. The Aeration Cascade Effluent flow rate was used in the weekly flow calculations in monthly reports for the VWTT prior to DEC 2014. The flow rates for the period 27 OCT 2014 - 16 NOV 2014 (and all other weeks) are now calculated based on the Settling Basin No. 2 influent flow rates to better represent metals mass removal by the VWTT.

Table 15. Hydrogen Sulfide Gas (ppm)

Horizontal and Vertical Wetland Treatment Trains

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

Phase	Week	Week of	H2S-01 (Aeration Channel Inlet)			H2S-02 (Access Road near Aeration Channel-South)			H2S-03 (Access Road near Aeration Channel-North)			H2S-04 (Access Road near Biotreatment Cell)			H2S-05 (Aeration Cascade Inlet)		
			average	minimum	maximum	average	minimum	maximum	average	minimum	maximum	average	minimum	maximum	average	minimum	maximum
C	W00	15-Sep-14	0.033	0	1.1	0.018	0	1.5	0.0024	0	0.2	0.000	0	0	0.002	0	0.4
C	W01	22-Sep-14	0.016	0	0.7	0.025	0	1	0.0000	0	0	0.000	0	0	0.003	0	0.4
C	W02	29-Sep-14	0.032	0	1.7	0.003	0	0.5	0.0000	0	0	0.007	0	1.1	0.004	0	0.7
C	W03	06-Oct-14	0.022	0	3	0.002	0	0.4	0.0000	0	0	0.004	0	0.7	0.006	0	0.6
C	W04	13-Oct-14	0.005	0	0.5	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W05	20-Oct-14	0.005	0	0.4	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W06	27-Oct-14	0.008	0	0.6	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W07	03-Nov-14	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W08	10-Nov-14	0.002	0	0.4	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W09	17-Nov-14	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W10	24-Nov-14	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W11	01-Dec-14	0.006	0	0.6	0.000	0	0	0.0000	0	0	0.000	0	0	0.002	0	0.4
C	W12	08-Dec-14	0.002	0	0.4	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W13	15-Dec-14	0.008	0	0.7	0.000	0	0	0.0000	0	0	0.000	0	0	0.011	0	0.6
C	W14	22-Dec-14	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
C	W15	29-Dec-14	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
TR01	W00	05-Jan-15	0.002	0	0.4	0.000	0	0	0.0000	0	0	0.000	0	0	0.005	0	0.4
TR01	W01	12-Jan-15	0.007	0	0.7	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
TR01	W02	19-Jan-15	0.002	0	0.4	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
TR01	W03	26-Jan-15	0.002	0	0.4	0.000	0	0	0.0000	0	0	0.000	0	0	0.002	0	0.4
TR01	W04	02-Feb-15	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.002	0	0.4
TR01	W05	09-Feb-15	0.002	0	0.4	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
TR01	W06	16-Feb-15	0.013	0	0.6	0.000	0	0	NA ¹	NA ¹	NA ¹	0.000	0	0	0.030	0	5
TR01	W07	23-Feb-15	0.033	0	0.8	0.000	0	0	NA ¹	NA ¹	NA ¹	0.000	0	0	0.012	0	0.4
TR01	W08	02-Mar-15	0.005	0	0.5	0.000	0	0	NA ¹	NA ¹	NA ¹	0.000	0	0	0.005	0	0.4
TR01	W09	09-Mar-15	0.000	0	0	0.000	0	0	NA ¹	NA ¹	NA ¹	0.000	0	0	0.000	0	0
TR01	W10	16-Mar-15	0.000	0	0	0.000	0	0	NA ¹	NA ¹	NA ¹	0.000	0	0	0.000	0	0
TR01	W11	23-Mar-15	0.002	0	0.4	0.000	0	0	NA ¹	NA ¹	NA ¹	0.000	0	0	0.000	0	0
TR01	W12	30-Mar-15	0.002	0	0.4	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
TR02	W00	06-Apr-15	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.005	0	0.9
TR02	W01	13-Apr-15	0.002	0	0.4	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
TR02	W02	20-Apr-15	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
TR02	W03	27-Apr-15	0.002	0	0.4	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
TR02	W04	04-May-15	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
TR02	W05	11-May-15	0.007	0	0.6	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
TR02	W06	18-May-15	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
TR02	W07	25-May-16	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
TR02	W08	01-Jun-15	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
TR02	W09	08-Jun-15	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
TR02	W10	15-Jun-15	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
TR02	W11	22-Jun-15	0.002	0	0.4	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
TR02	W12	29-Jun-15	0.007	0	0.6	0.000	0	0	0.0000	0	0	0.000	0	0	0.000	0	0
TR02	W13	06-Jul-15	0.017	0	1.4	0.002	0	0.4	0.0000	0	0	0.000	0	0	0.000	0	0
TR02	W14	13-Jul-15	0.007	0	0.7	0.005	0	0.4	0.0000	0	0	0.000	0	0	0.000	0	0
TR02	W15	20-Jul-15	0.002	0	0.4	0.004	0	0.6	0.0000	0	0	0.000	0	0	0.000	0	0
TR02	W16	27-Jul-15	0.000	0	0	0.000	0	0	0.0000	0	0	0.000	0	0	0.011	0	0.6

NOTES:</b

Wetland Plant Update

AUGUST 2015

St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study

Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01

RICO WETLAND DEMONSTRATION PROJECT - SF and HSSF WETLAND CELLS

August 24, 2015 Monitoring



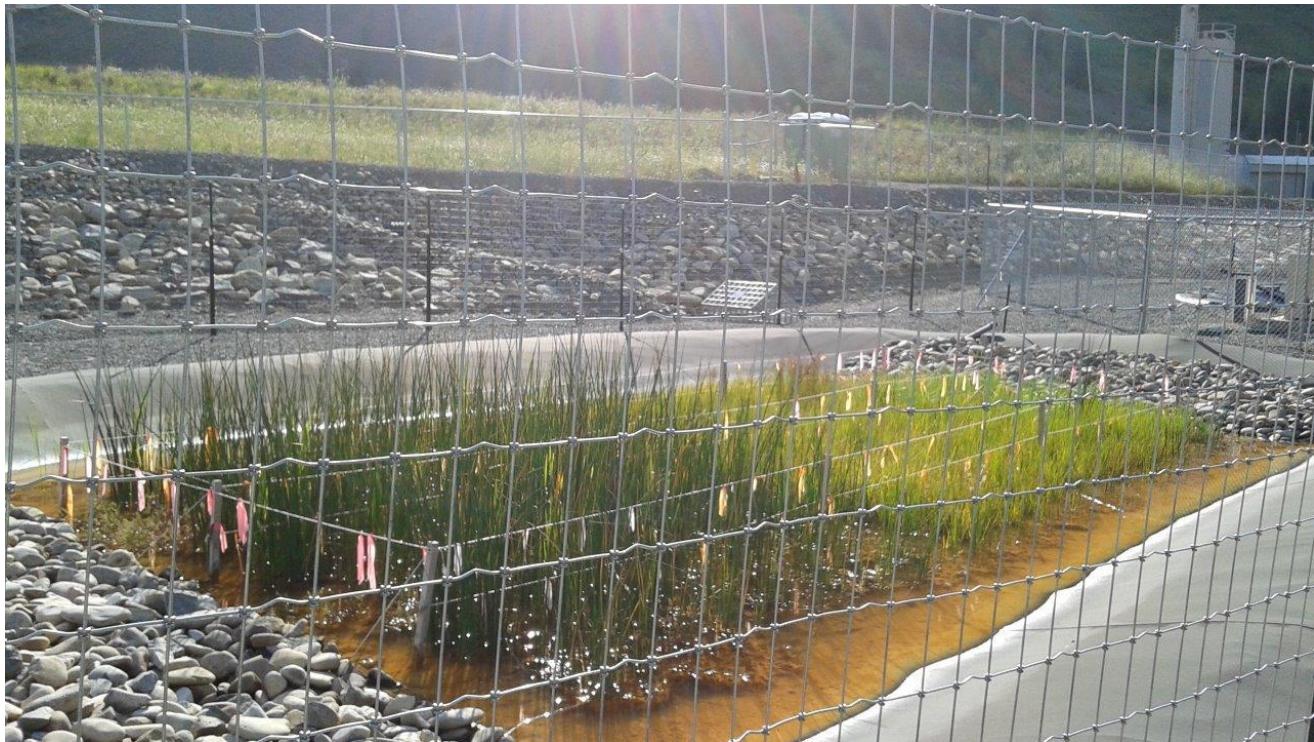
Photograph 1: SF Wetland with Planted Bulrush and Sedge – Looking South on August 24, 2015



Photograph 2: SF Wetland with Planted Bulrush and Sedge – Looking West on August 24, 2015

RICO WETLAND DEMONSTRATION PROJECT - SF and HSSF WETLAND CELLS

August 24, 2015 Monitoring



Photograph 3: SF Wetland with Planted Bulrush and Sedge - Looking Southeast on August 24, 2015



Photograph 4: SF Wetland with Planted Sedge - Looking Southeast on August 24, 2015

RICO WETLAND DEMONSTRATION PROJECT - SF and HSSF WETLAND CELLS

August 24, 2015 Monitoring



Photograph 5: SF Wetland with Planted Bulrush and Sedge - Looking Northeast on August 24, 2015



Photograph 6: SF Wetland Close-up of Planted Bulrush and Sedge on August 24, 2015

RICO WETLAND DEMONSTRATION PROJECT - SF and HSSF WETLAND CELLS

August 24, 2015 Monitoring



Photograph 7: HSSF Wetland with Establishing Wetland Plants – Looking South on August 24, 2015



Photograph 8: HSSF Wetland –Sampling Points Comparing Planted Vegetation
on either side of Southwestern FRP on August 24, 2015

RICO WETLAND DEMONSTRATION PROJECT - SF and HSSF WETLAND CELLS

August 24, 2015 Monitoring



Photograph 9: HSSF Wetland –Sampling Points Comparing Planted Vegetation on either side of Southwestern FRP on August 24, 2015



Photograph 10: HSSF Wetland - Sampling Point Comparing Planted Vegetation on either side of Southwestern FRP on August 24, 2015

RICO WETLAND DEMONSTRATION PROJECT - SF and HSSF WETLAND CELLS

August 24, 2015 Monitoring



Photograph 11: HSSF Wetland – Sampling Point in Matrix –
Located East of Middle FRP on August 24, 2015



Photograph 12: HSSF Wetland – Sampling Point in Northern Soil Test Strip
Reviewing Planted Wetland Vegetation Success on August 24, 2015

RICO WETLAND DEMONSTRATION PROJECT - SF and HSSF WETLAND CELLS

August 24, 2015 Monitoring



Photograph 13: HSSF Wetland – Sampling Point Located in Southeast Quadrant
East of Southeast FRP on August 24, 2015

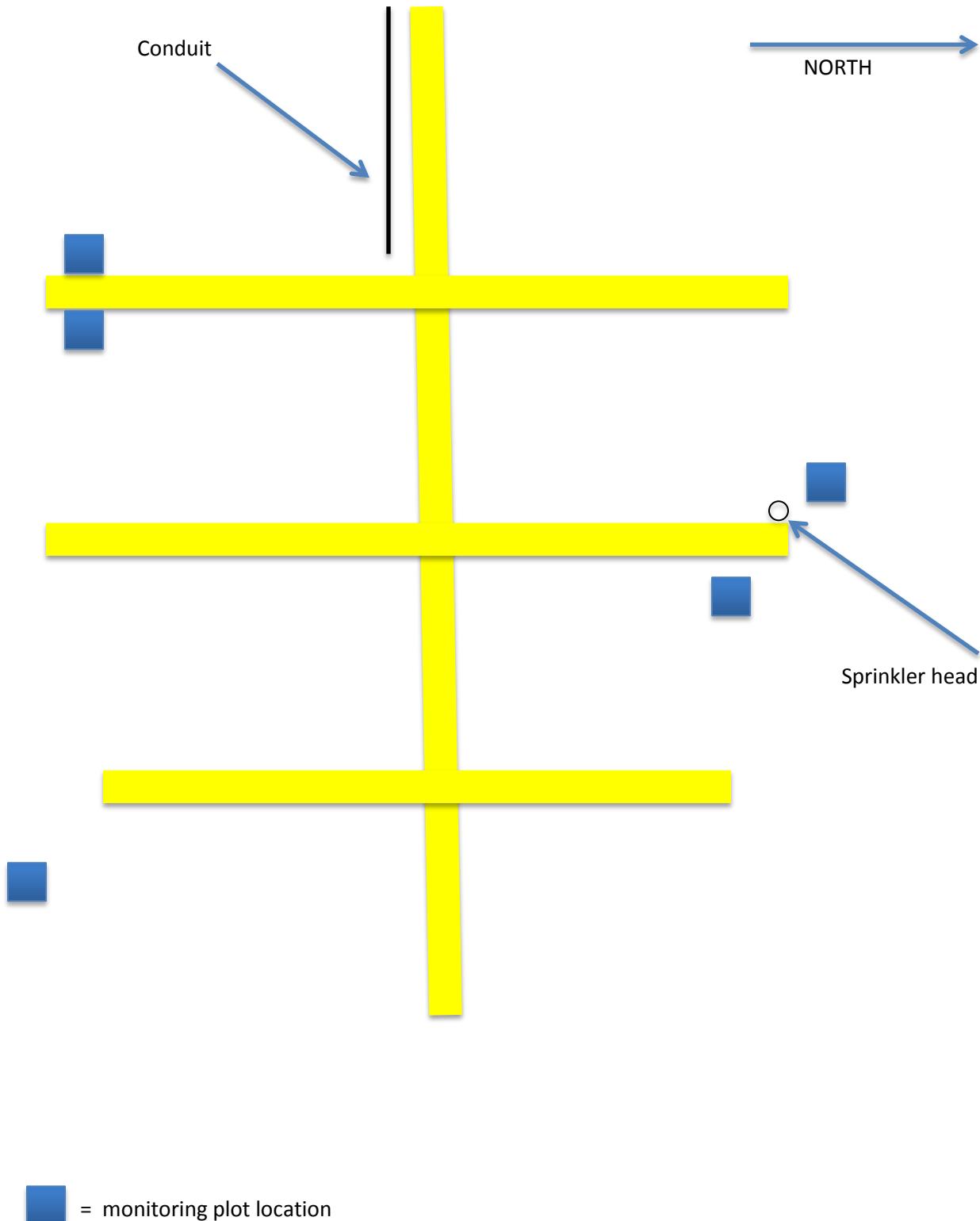


Photograph 14: HSSF Wetland – Close-up Photo of Southern Soil Test Strip
showing Established Wetland Plants on August 24, 2015

RICO WETLAND DEMONSTRATION PROJECT - SF and HSSF WETLAND CELLS

August 24, 2015 Monitoring

HSSE Wetland Plant - Monitoring Plot Locations



Attachment 2



A BP affiliated company

Atlantic Richfield Company

Anthony R. Brown
Project Manager Mining

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August 21, 2015
Mr. Steven Way
On-Scene Coordinator
Emergency Response Program (8EPR-SA)
U.S. EPA, Region 8
1595 Wynkoop Street
Denver, CO 80202-1129

RE: Performance Summary Technical Memorandum
Period of September 15, 2014 through July 15, 2015
St. Louis Tunnel Discharge Constructed Wetland Demonstration Treatability Study
Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01
Dolores County, Colorado

Dear Mr. Way:

This Technical Memorandum presents a summary of the Rico-Argentine Mine Site Constructed Wetland Demonstration (CWD) Treatability Study performance for the period of September 15, 2014 through July 15, 2015. The system performance during the 2015 spring freshet, defined as early May through mid-July 2015, is highlighted and compared to the system performance since system startup.

St. Louis Tunnel Discharge (CWD Influent) Water Quality

Prior to the 2015 spring freshet at Rico, the concentrations of cadmium, copper, manganese, nickel, and zinc at the Flow Diversion Box (FDB, input to the CWD) remained relatively stable, with maximum values exceeding minimum values by approximately one-third. Water pH was very constant as well, averaging 6.8 S.U. since the beginning of 2015. The St. Louis Tunnel provided relatively consistent water quality during this time.

The abrupt decrease in water pH to <6.3 S.U. from May 7 to June 11 was the first indicator of the spring freshet. Cadmium, copper, manganese, nickel, and zinc concentrations in St. Louis Tunnel discharge water increased by 300%, 195%, 130%, 125%, and 255%, respectively, on May 21. These concentrations peaked and then fell back to near pre-freshet conditions in late July. Sulfate concentrations rose and fell with metals concentrations, but the concentration changes were more subtle. Charts displaying FDB aluminum, arsenic, cadmium, copper, iron, manganese, nickel, lead, zinc, pH, alkalinity, and sulfate data are presented in Figure A-1 through Figure A-12 of Appendix A.

Vertical Wetland Treatment Train Performance

After the initial colonization period ended in December 2014, effluent from the VWTT (as measured at the Aeration Cascade effluent point, AC2EFF) consistently met 2008 WQA targets for all metals for all sampling events conducted through May 6, 2015. Data collected during the freshet period (May 21 through July 7, 2015, the last dataset available), demonstrate that the VWTT effluent continued to meet these targets for all metals, except manganese and zinc. Exceedance of some 2008 WQA targets was not unexpected during this period. A deliberate effort was made to simulate operation of a full-scale system and attempt to achieve chemical breakthrough prior to the freshet. This was done by increasing the VWTT flow rate by approximately 20% in late March 2015, and by initially running the VWTT biotreatment cell at a substantially reduced water level. Early during the freshet, water levels in the Biocell were elevated to maintain metal removal rates in response to increased loadings. An earlier or proactive response to the freshet could have potentially limited the effects of breakthrough. Charts



displaying VWTT effluent aluminum, arsenic, cadmium, copper, iron, manganese, nickel, lead, and zinc data and respective 2008 WQA targets are presented in Figure B-1 through Figure B-9 of Appendix B.

Horizontal Wetland Treatment Train Performance

The HWTT was severely challenged during the spring freshet. The Horizontal Subsurface Flow (HSSF) wetland became less effective in producing hydrogen sulfide midway through the freshet and metals removal was limited. This was compensated by effective metal polishing in the Rock Drain that resulted in only limited exceedances of Cd, Cu, and Zn 2008 WQA standards during the freshet.

Despite changes in feed composition, Settling Basin No. 1 (SB1) produced a low turbidity (25-20 NTU) and low iron (<1.5 mg/L) effluent throughout freshet. Surprisingly, the pH of SB1 effluent decreased to <6.0 S.U. in late May, leveled off at 6.2 S.U. by mid-June, then gradually increased to >6.5 S.U. by early July. The lower water pH delivered to the HSSF Wetland during the freshet impaired the wetland performance by: increasing effluent oxidation-reduction potential (ORP), reducing sulfide production, and resulted in less effective metals removal. Water levels in the wetland were increased to mitigate these problems, but it only restored normal operating ORP (i.e., <-300 mV) temporarily.

Residual cadmium, copper, and zinc present in the HSSF wetland effluent during the freshet were removed by 80-95% in the Rock Drain. Additionally, the absence of sulfide in HSSF wetland effluent during spring freshet improved manganese removal to >80%. Charts showing HWTT effluent aluminum, arsenic, cadmium, copper, iron, manganese, nickel, lead, and zinc data and respective 2008 WQA targets are presented in Figure C-1 through Figure C-9 of Appendix C.

Summary of Findings and Future Additional Study

The following lessons were learned during operation of the VWTT through the 2015 spring freshet:

- Declining pH (dropping below 6.5 S.U.) can be a leading indicator of rising metals concentrations in St. Louis Tunnel discharge and is measured fairly continuously in the inflow of St. Louis Tunnel water to the wetlands. Along with a knowledge of the freshet cycle gained from this wetland demonstration project, pH can be used as an indicator to implement a proactive strategy of maximizing hydraulic residence times when influent pH values decrease below 6.5 S.U.
- Peak cadmium, manganese, nickel, and zinc concentrations observed in spring 2015 are above or near respective peak concentrations observed in historic site data and likely represent plausible “worst-case” concentrations that may recur on an annual basis, beginning in late April.
- CWD monitoring data appears to confirm observations from less detailed historic monitoring data that metals concentrations will remain elevated above baseline for at least eight to twelve weeks during a freshet cycle.
- Low pH influent appeared to reduce solids removal capacity in Settling Basin No. 2 and negatively impact bacterial activity in the Biotreatment Cell. Addition of a system to maintain neutral pH (i.e., a seasonal or permanent pH modification system) may be beneficial to system operation and consistent achievement of 2008 WQA targets.
- Even in a best case scenario, at peak spring metals loading some seasonal exceedances of 2008 WQA targets could occur.

Important lessons were learned for the HWTT during spring freshet, including:

- Influent pH < 6.2 S.U. impaired sulfur reducing bacteria activity, sulfide production, and metals removal. Adjustment of water pH above this level will be beneficial during future freshets.
- Wetland ORP was confirmed as a key operating parameter. Metal removal rates will decrease when effluent ORP increases above -100 mV.
- Increased water depth in the HSSF wetland helped to decrease ORP and increase sulfide production, but this effect was found to be temporary if water pH is < 6.2 S.U.
- Previously noted impairment of manganese removal was confirmed to be due to excessive sulfide concentrations in the Aeration Channel effluent. Effective manganese removal was restored when aeration channel effluent sulfide concentrations became negligible.



- Manganese deposits in the Rock Drain removed dissolved metals very effectively. When located downstream from the treatment system, they polish residual metals from the system effluent.

Support for the Enhanced Wetlands Demonstration (EWD) Design

Although the schedule required design of the EWD prior to collecting data from the CWD in the 2015 freshet season, the data and observations generally support the EWD design.

Both horizontal and vertical wetlands show promising results during the major part of the season, however, the vertical system showed more stability during the freshet season. The short migration distance through the media provide for use of media with greater organic matter content, more consistent reducing conditions at depth, more consistent hydrogen sulfide production, and a smaller footprint for the Biotreatment Cell. Important differences between the long term operational costs associated with each system are still to be resolved.

The Rock Drain associated with the Horizontal System showed periods of excellent performance when it was not loaded with hydrogen sulfide and other reduced compounds from the HSSF wetland. This concept is incorporated into the Manganese Removal Cell of the EWD, but placed ahead of anaerobic wetlands cells to provide a better environment for oxidation and manganese-oxidizing bacterial growth. It is hoped that the system will reduce manganese and also some of the other metals that were controlled in the CWD Rock Drain (e.g., zinc). An important modification has been made by incorporating plastic stationary media instead of the traditional carbonate rock used in the CWD. This change was based on availability and logistics of the media.

If you have any questions regarding this Technical Memorandum, please feel free to contact me at (714) 228-6770 or via e-mail at Anthony.Brown@bp.com.

Sincerely,

Tony Brown
Project Manager Mining
Atlantic Richfield Company

Appendix A - Flow Diversion Box Data Charts

- Figure A-1 Flow Diversion Box Aluminum Data
- Figure A-2 Flow Diversion Box Arsenic Data
- Figure A-3 Flow Diversion Box Cadmium Data
- Figure A-4 Flow Diversion Box Copper Data
- Figure A-5 Flow Diversion Box Iron Data
- Figure A-6 Flow Diversion Box Lead Data
- Figure A-7 Flow Diversion Box Manganese Data
- Figure A-8 Flow Diversion Box Nickel Data
- Figure A-9 Flow Diversion Box Zinc Data
- Figure A-10 Flow Diversion Box pH Data
- Figure A-11 Flow Diversion Box Alkalinity Data
- Figure A-12 Flow Diversion Box Sulfate Data

Appendix B – Vertical Wetland Treatment Train Data Charts

- Figure B-1 VWTT Aeration Cascade Effluent Aluminum Data
- Figure B-2 VWTT Aeration Cascade Effluent Arsenic Data
- Figure B-3 VWTT Aeration Cascade Effluent Cadmium Data
- Figure B-4 VWTT Aeration Cascade Effluent Copper Data
- Figure B-5 VWTT Aeration Cascade Effluent Iron Data
- Figure B-6 VWTT Aeration Cascade Effluent Lead Data
- Figure B-7 VWTT Aeration Cascade Effluent Manganese Data
- Figure B-8 VWTT Aeration Cascade Effluent Nickel Data
- Figure B-9 VWTT Aeration Cascade Effluent Zinc Data

Appendix C – Horizontal Wetland Treatment Train Data Charts

- Figure C-1 HWTT Aeration Cascade Effluent Aluminum Data
- Figure C-2 HWTT Aeration Cascade Effluent Arsenic Data
- Figure C-3 HWTT Aeration Cascade Effluent Cadmium Data
- Figure C-4 HWTT Aeration Cascade Effluent Copper Data
- Figure C-5 HWTT Aeration Cascade Effluent Iron Data
- Figure C-6 HWTT Aeration Cascade Effluent Lead Data
- Figure C-7 HWTT Aeration Cascade Effluent Manganese Data
- Figure C-8 HWTT Aeration Cascade Effluent Nickel Data
- Figure C-9 HWTT Aeration Cascade Effluent Zinc Data

Appendix A - Flow Diversion Box Data Charts

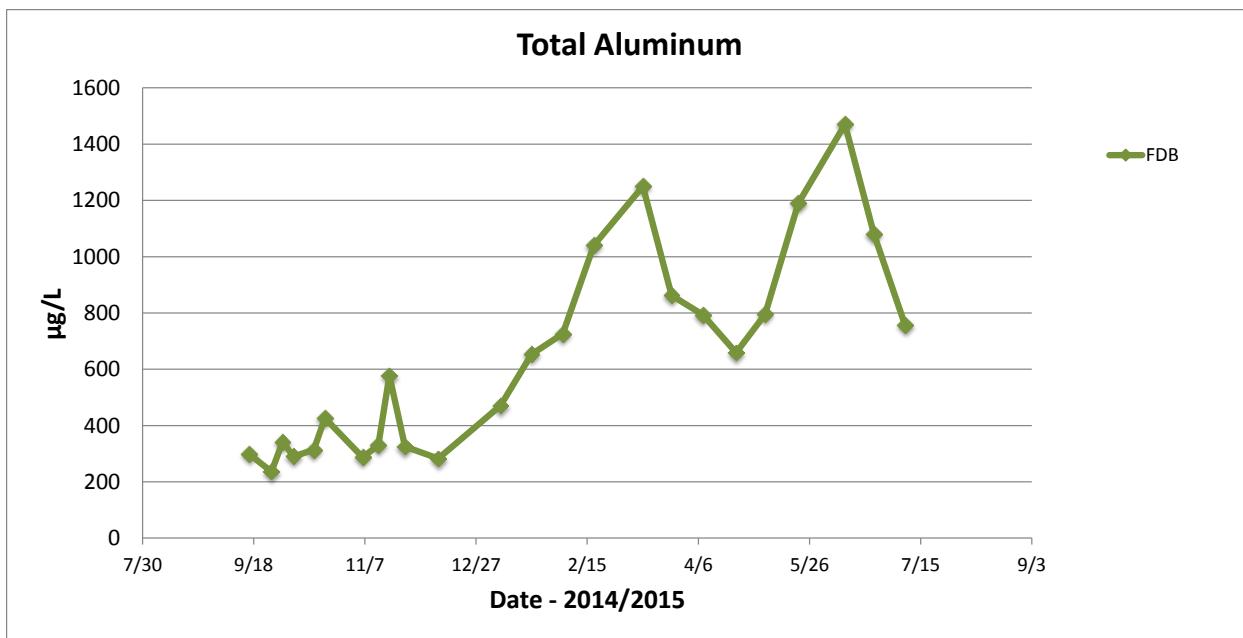


Figure A-1. Flow Diversion Box Aluminum Data.

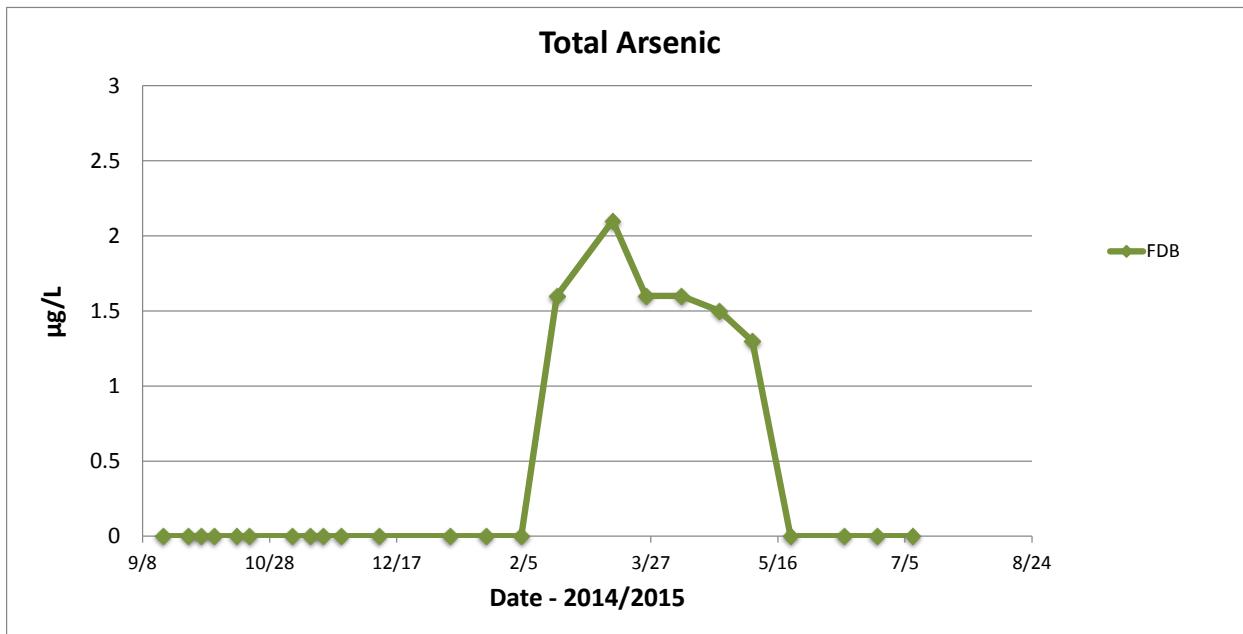


Figure A-2. Flow Diversion Box Arsenic Data

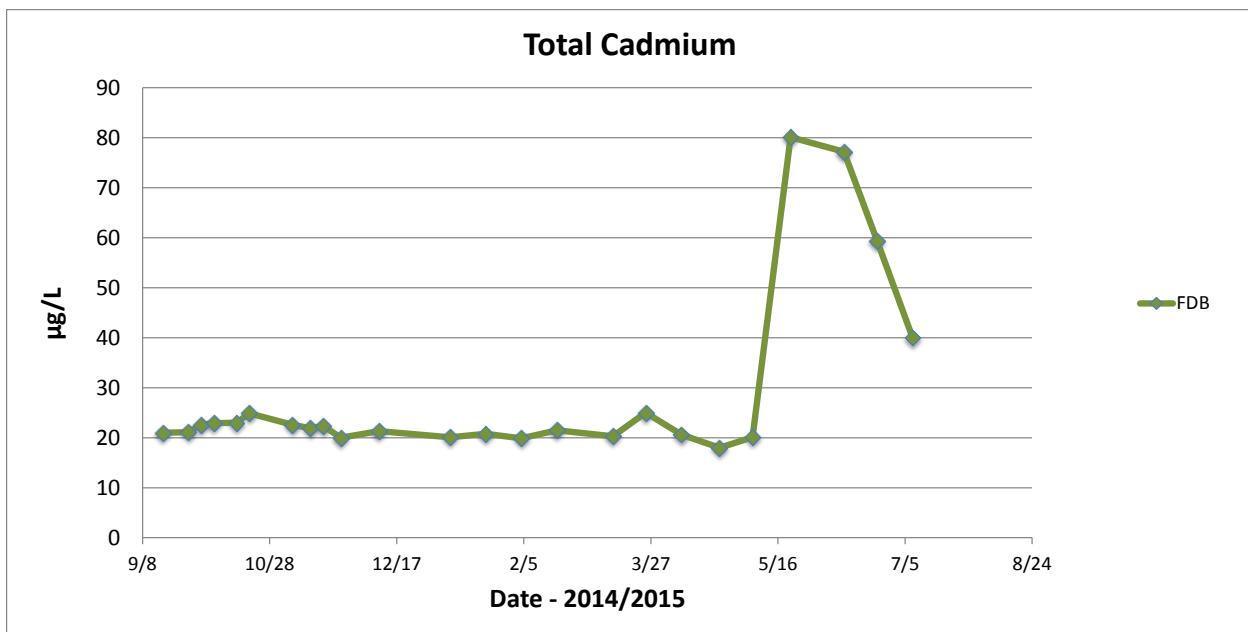


Figure A-3. Flow Diversion Box Cadmium Data

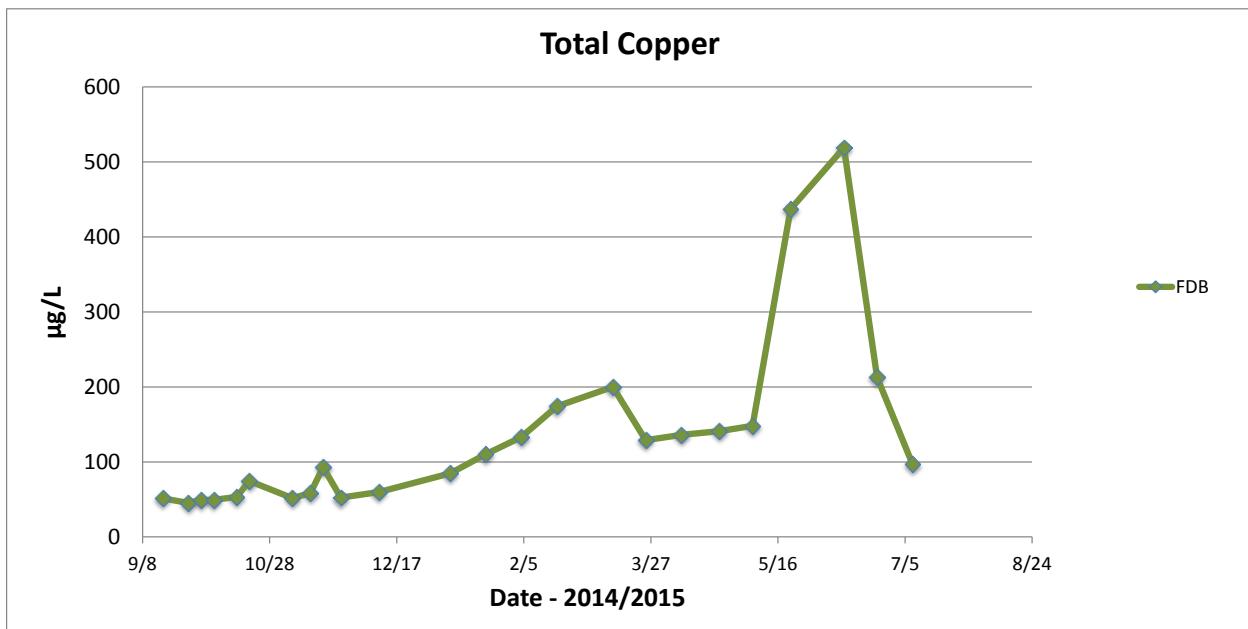


Figure A-4. Flow Diversion Box Copper Data

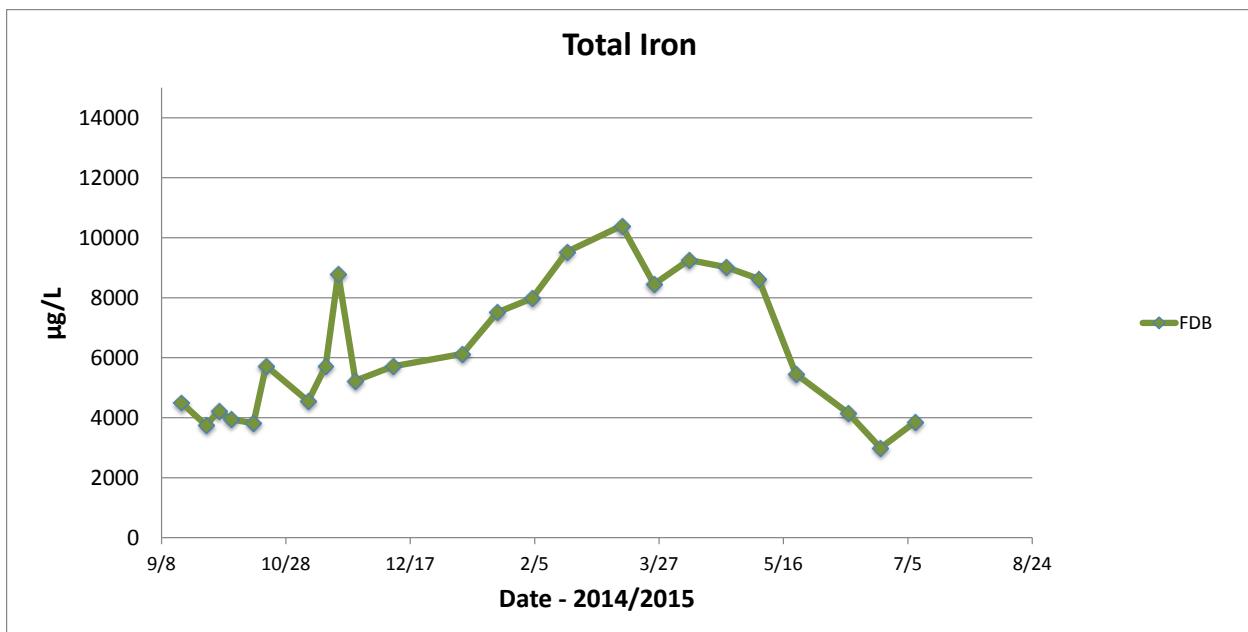


Figure A-5. Flow Diversion Box Iron Data

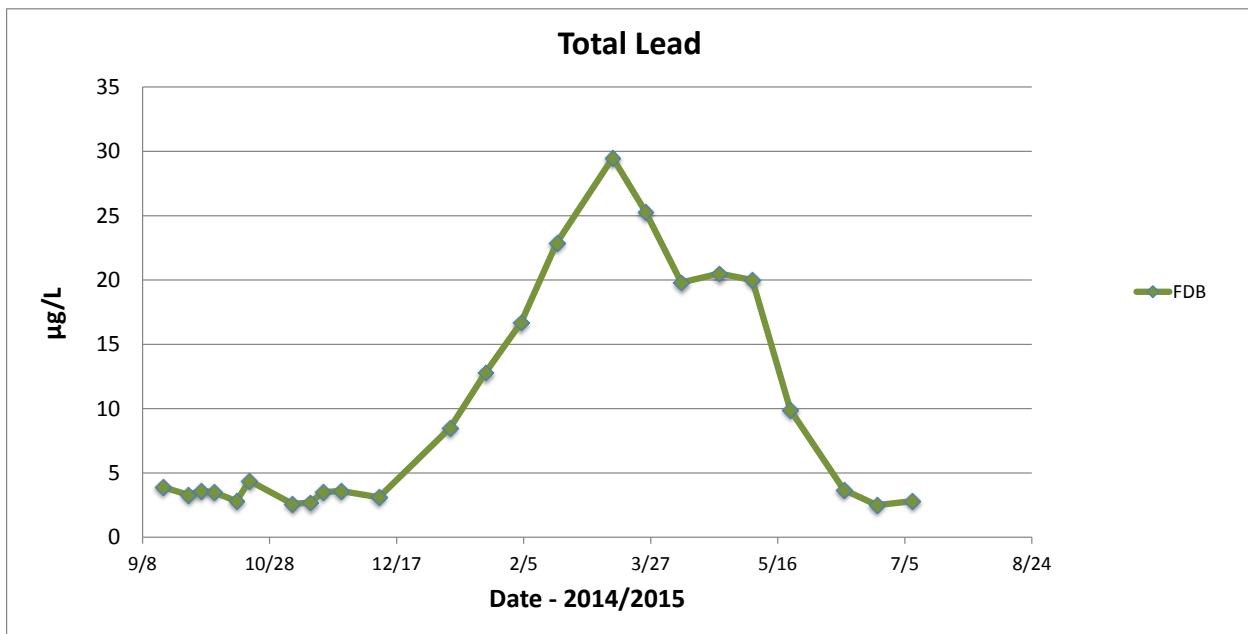


Figure A-6. Flow Diversion Box Lead Data

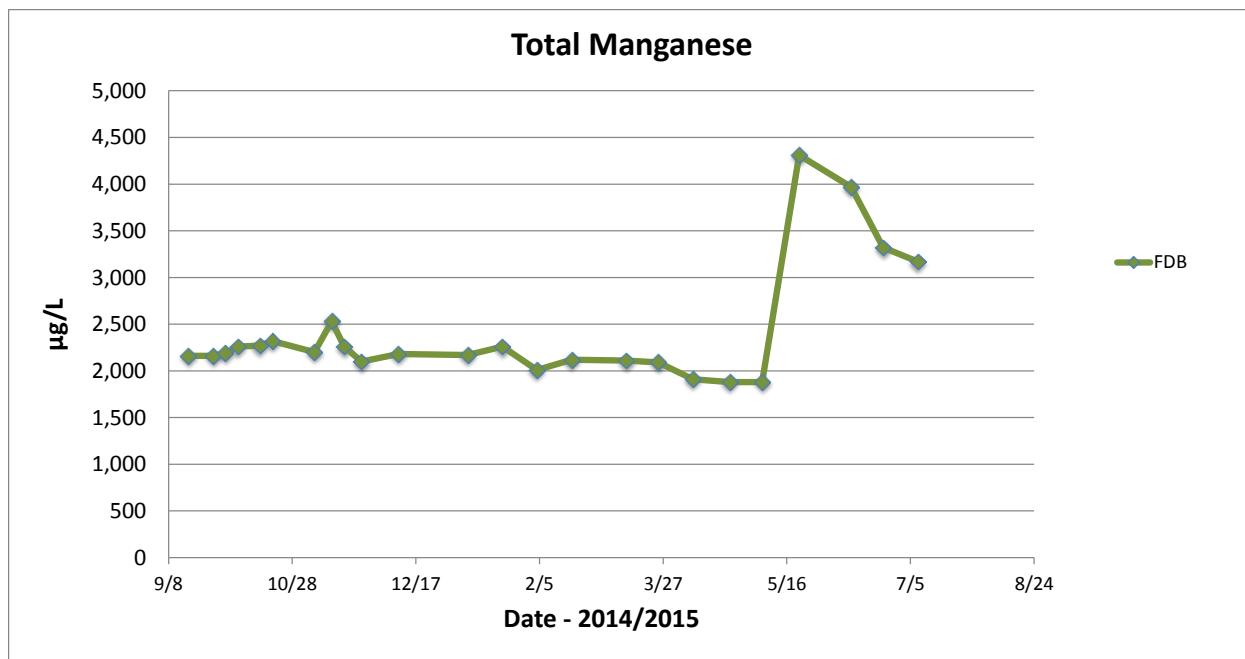


Figure A-7. Flow Diversion Box Manganese Data

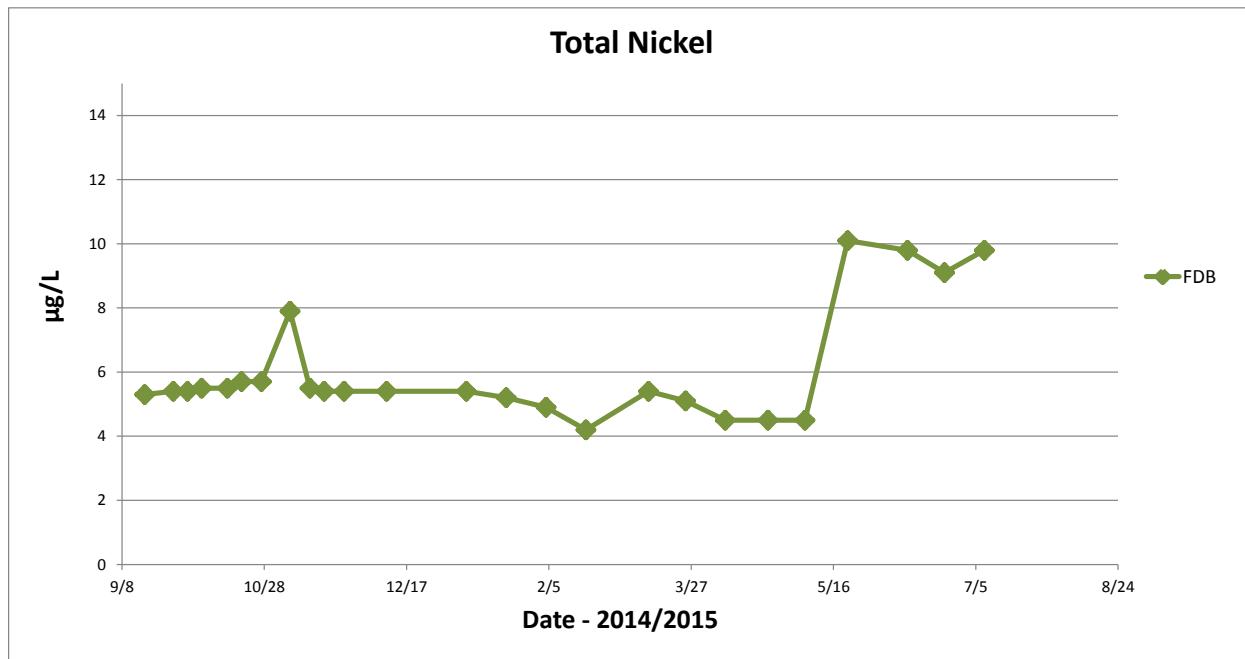


Figure A-8. Flow Diversion Box Nickel Data

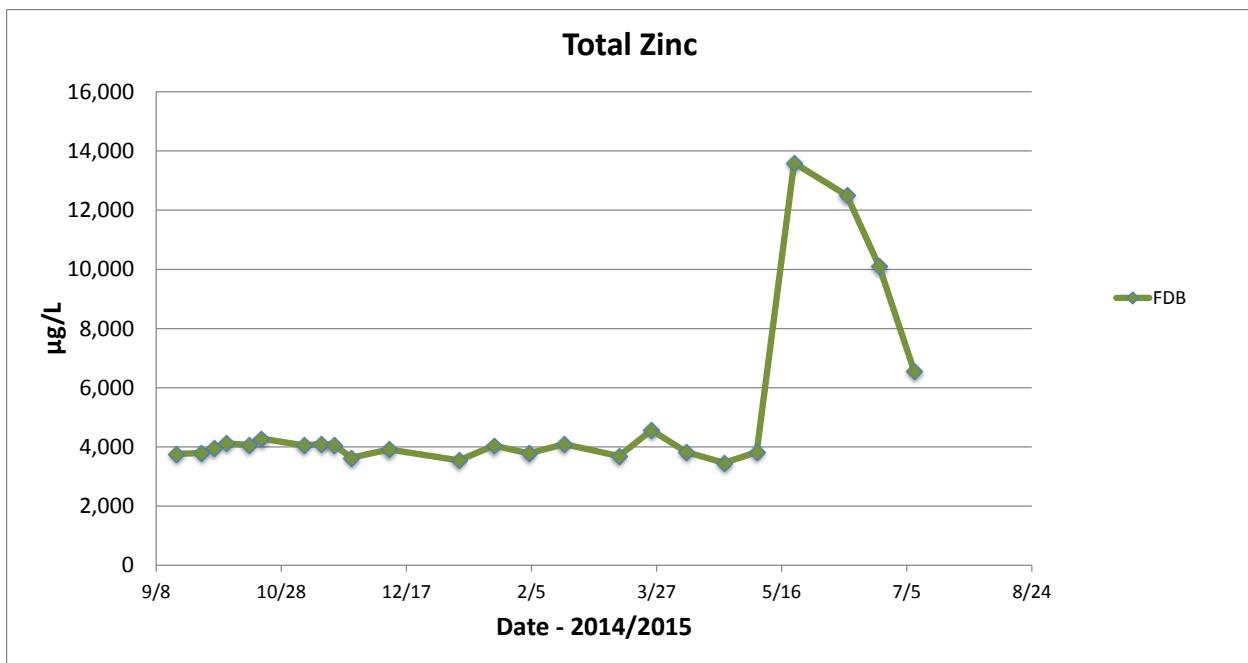


Figure A-9. Flow Diversion Box Zinc Data

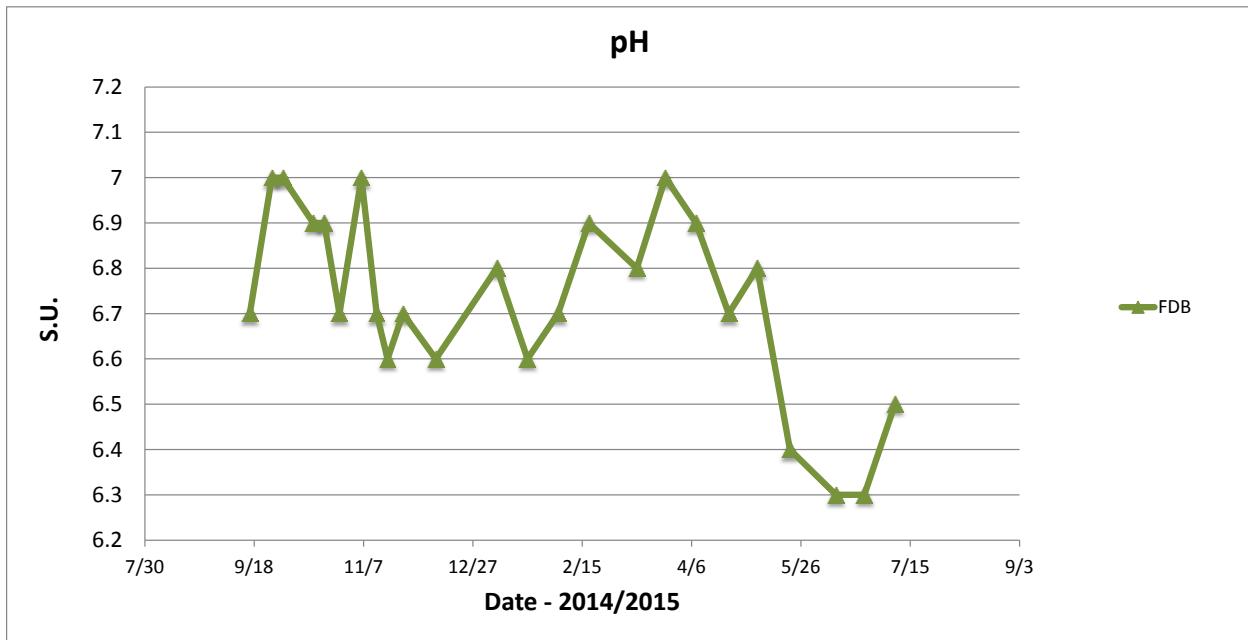


Figure A-10. Flow Diversion Box pH Data

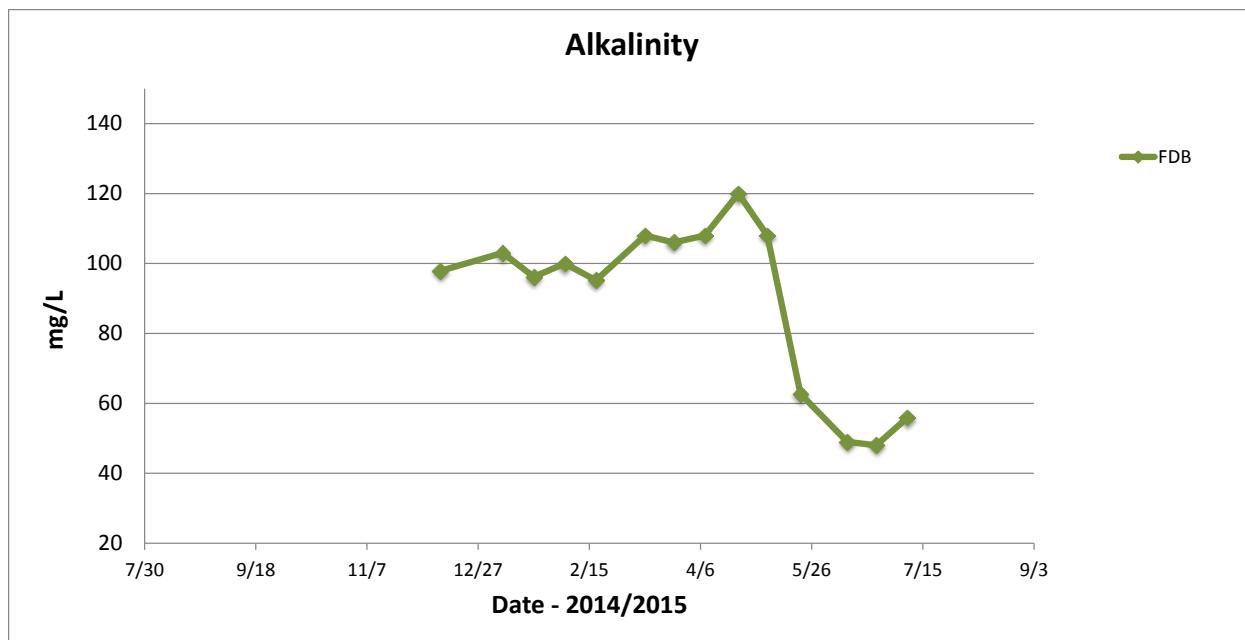


Figure A-11. Flow Diversion Box Alkalinity Data

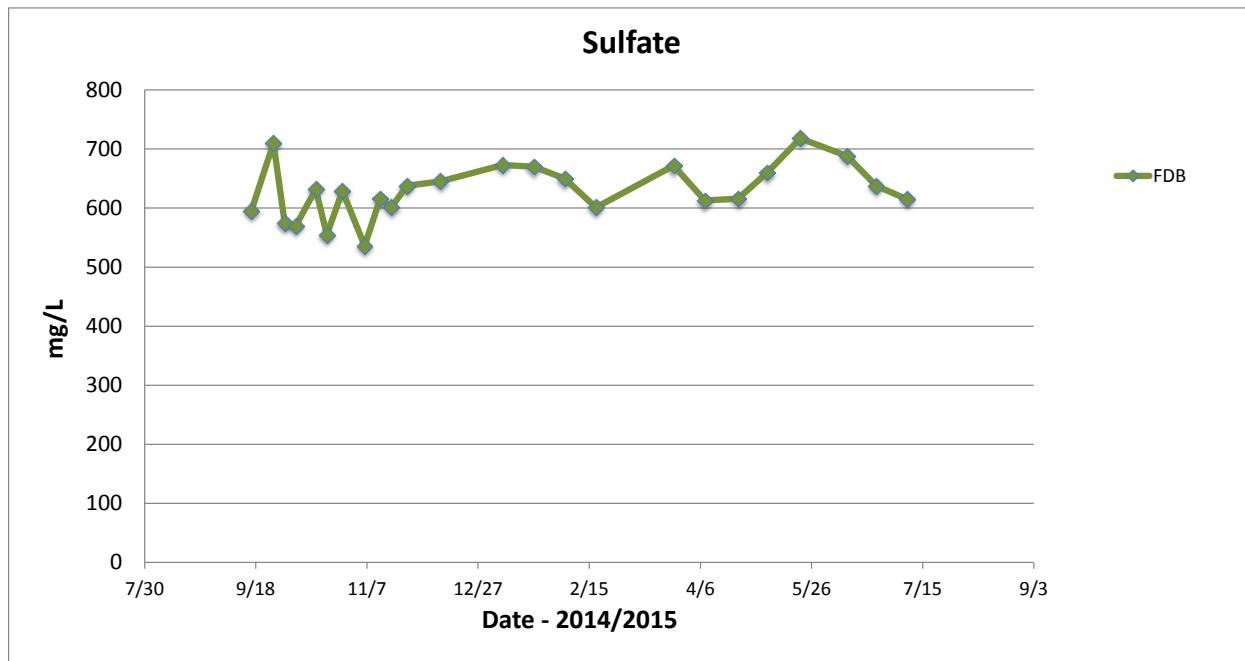


Figure A-12. Flow Diversion Box Sulfate Data

Appendix B – Vertical Wetland Treatment Train Data Charts

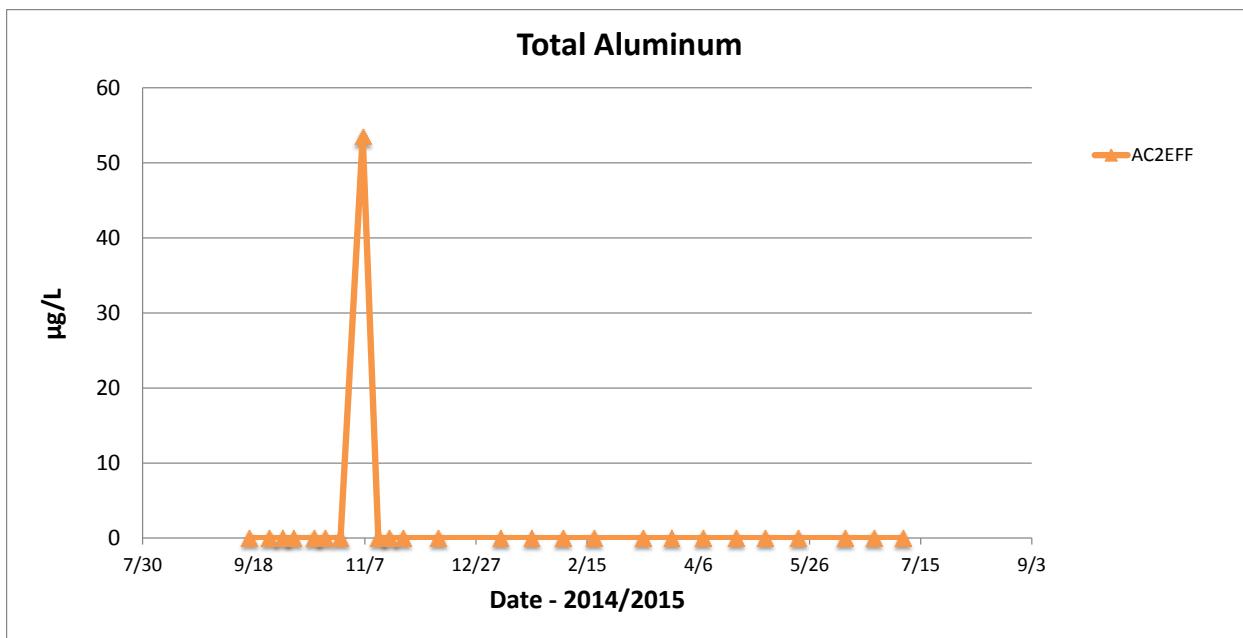


Figure B-1. VWTT Aeration Cascade Effluent Aluminum Data.

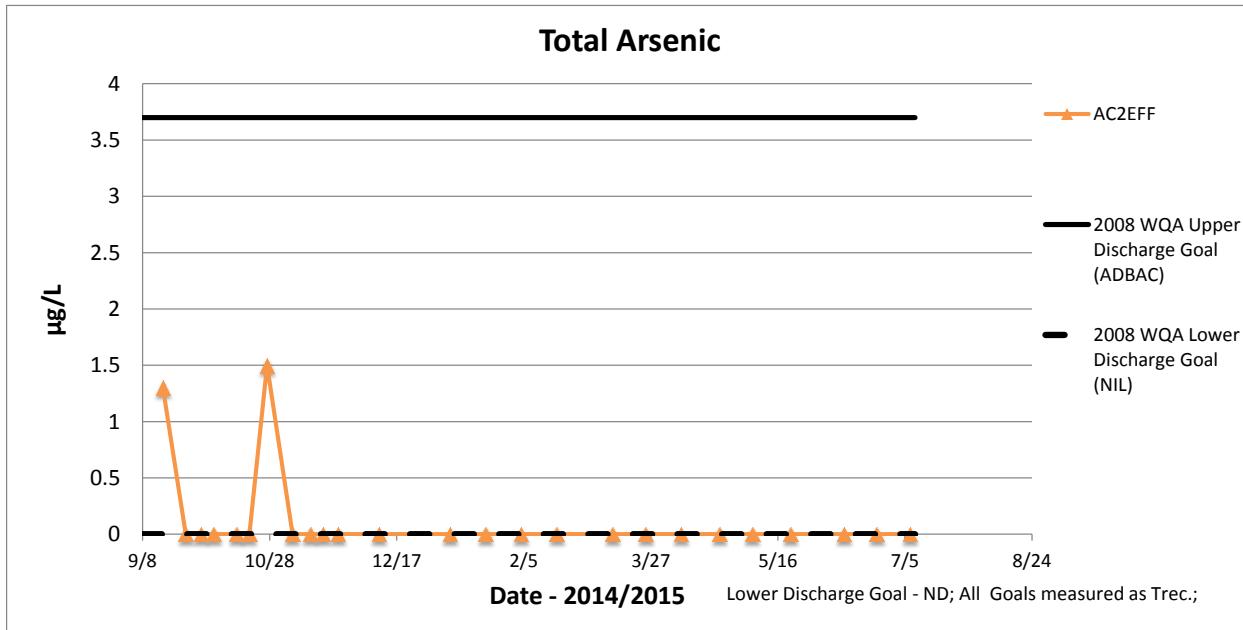


Figure B-2. VWTT Aeration Cascade Effluent Arsenic Data

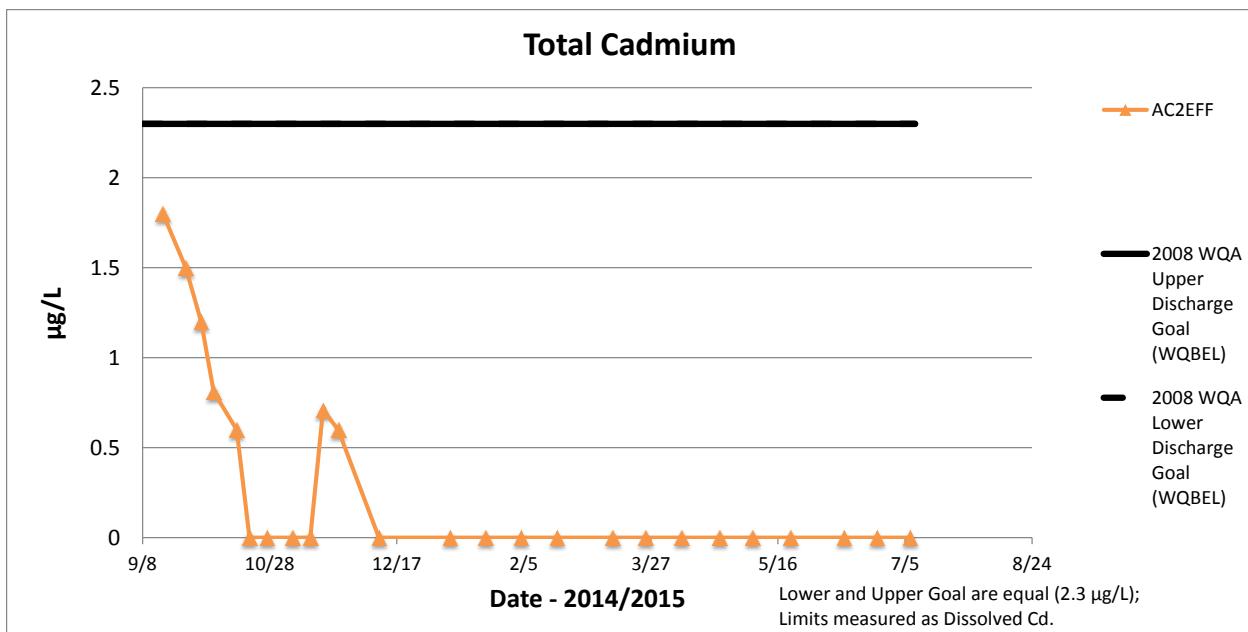


Figure B-3. VWTT Aeration Cascade Effluent Cadmium Data

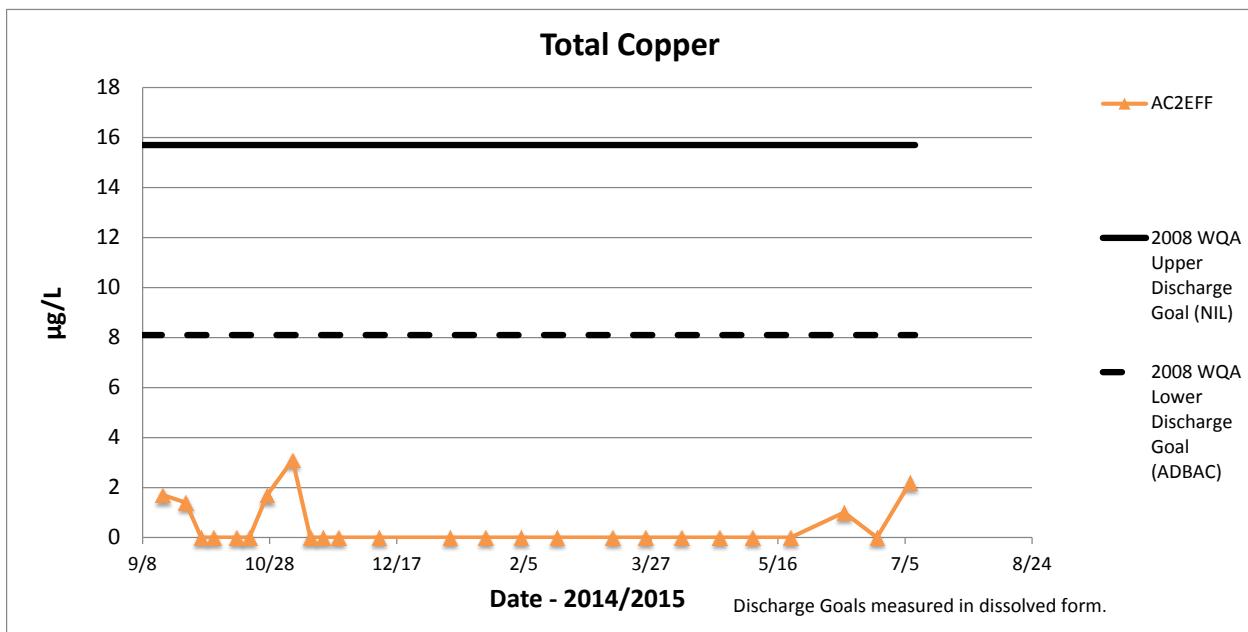


Figure B-4. VWTT Aeration Cascade Effluent Copper Data

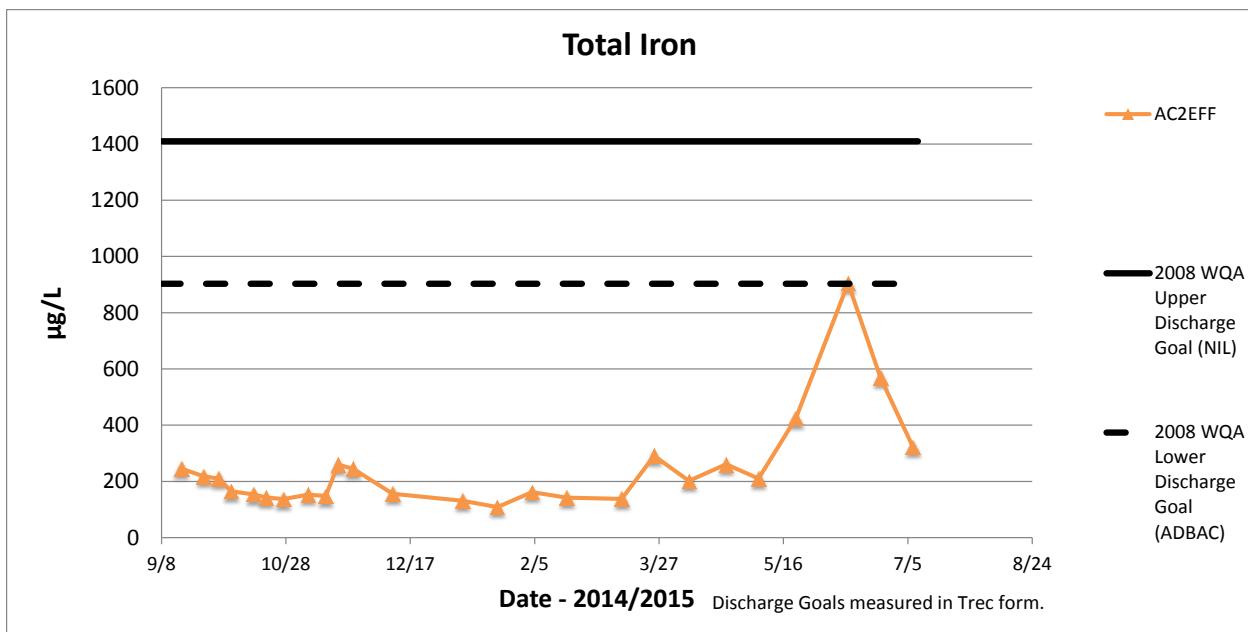


Figure B-5. VWTT Aeration Cascade Effluent Iron Data

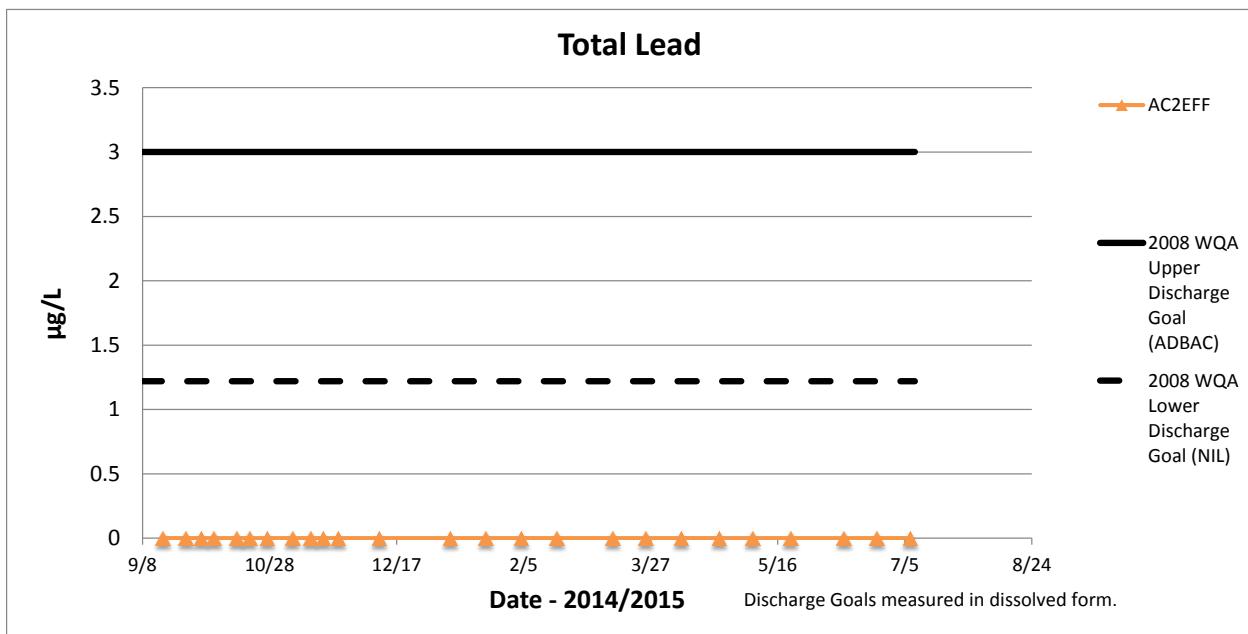


Figure B-6. VWTT Aeration Cascade Effluent Lead Data

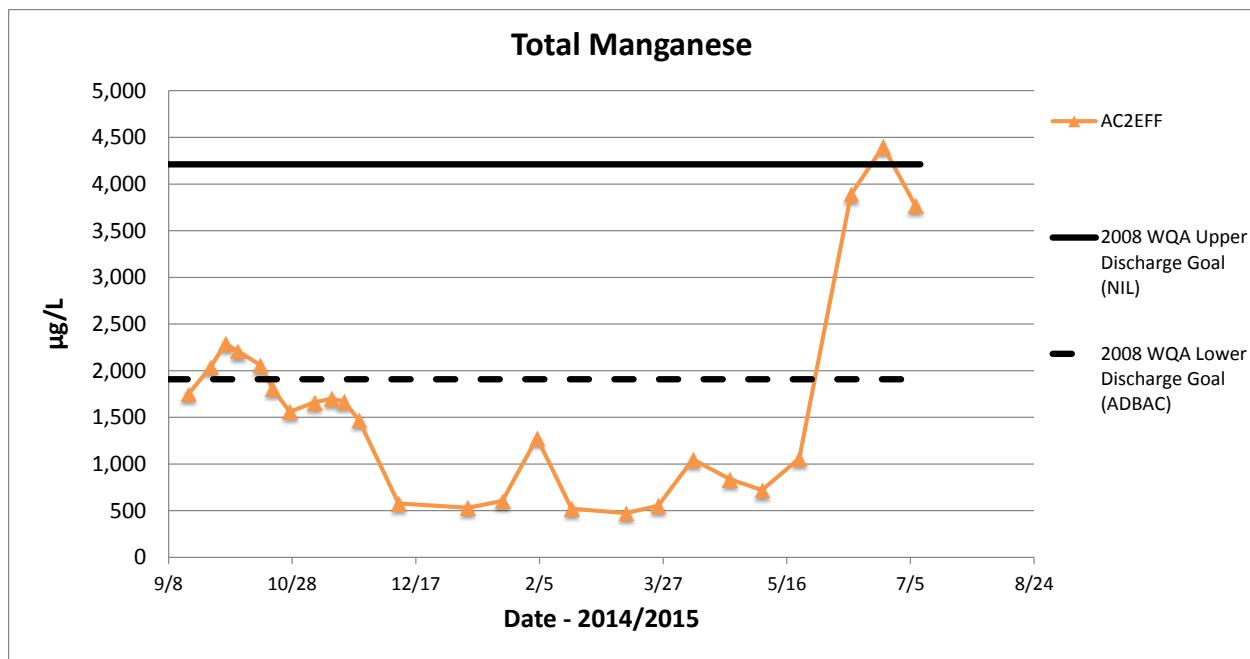


Figure B-7. VWTT Aeration Cascade Effluent Data

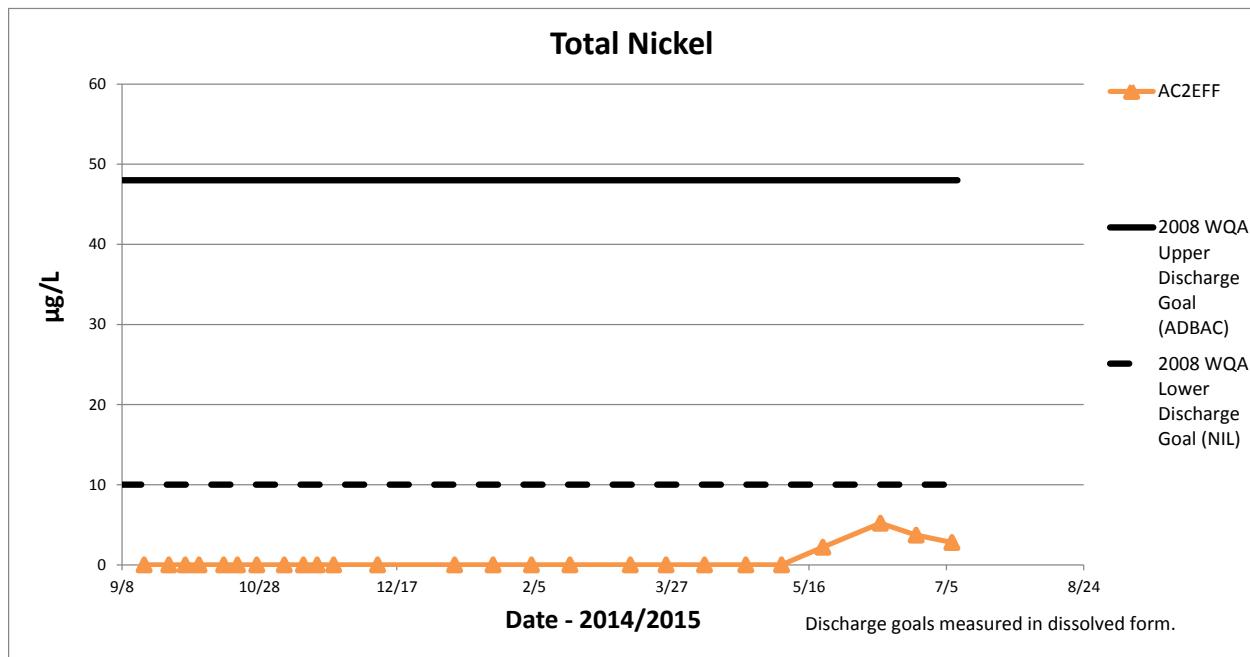


Figure B-8. VWTT Aeration Cascade Effluent Nickel Data

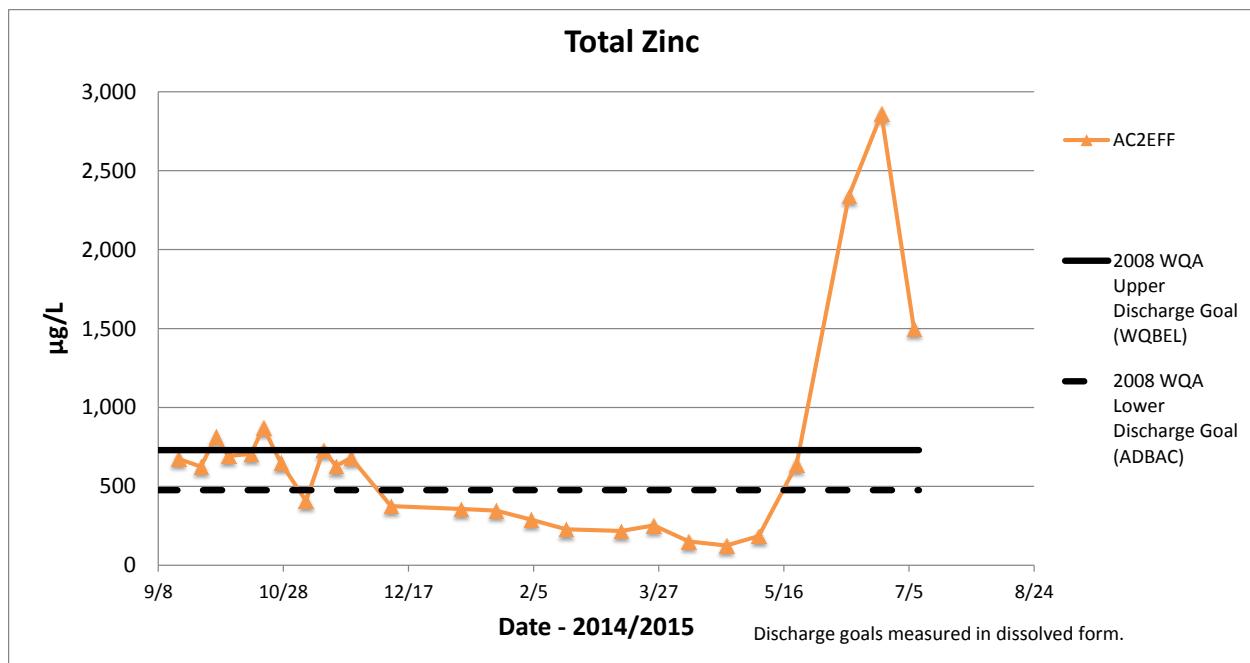


Figure B-9. VWTT Aeration Cascade Effluent Zinc Data

Appendix C – Horizontal Wetland Treatment Train Data Charts

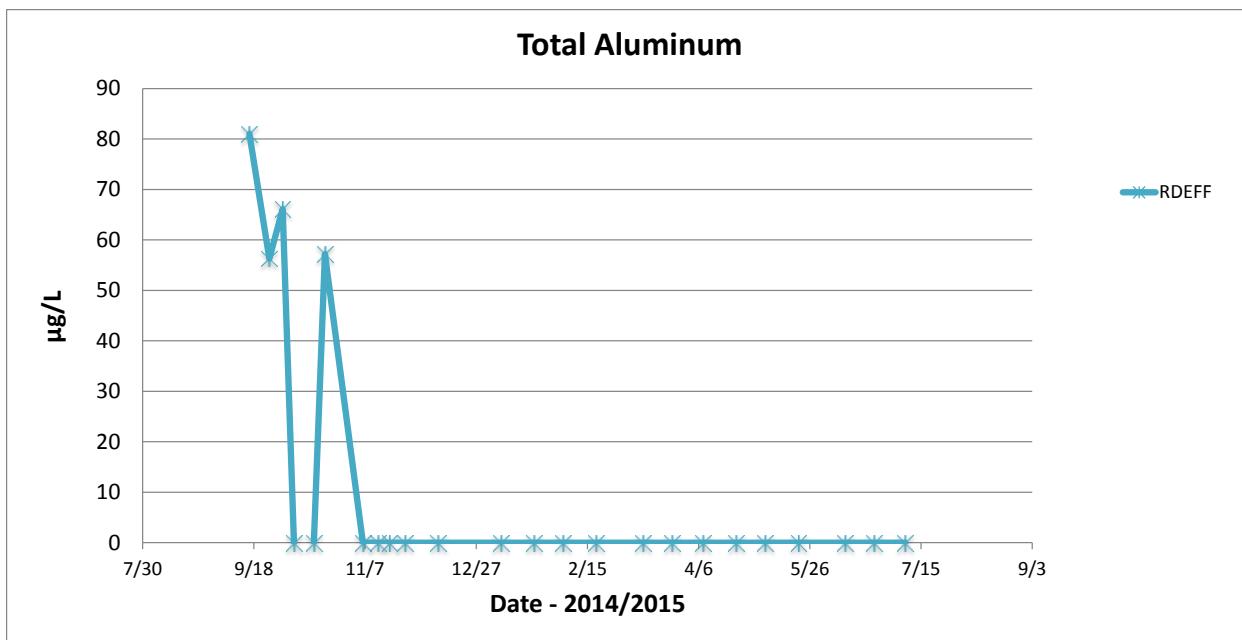


Figure C-1. HWTT Rock Drain Effluent Aluminum Data.

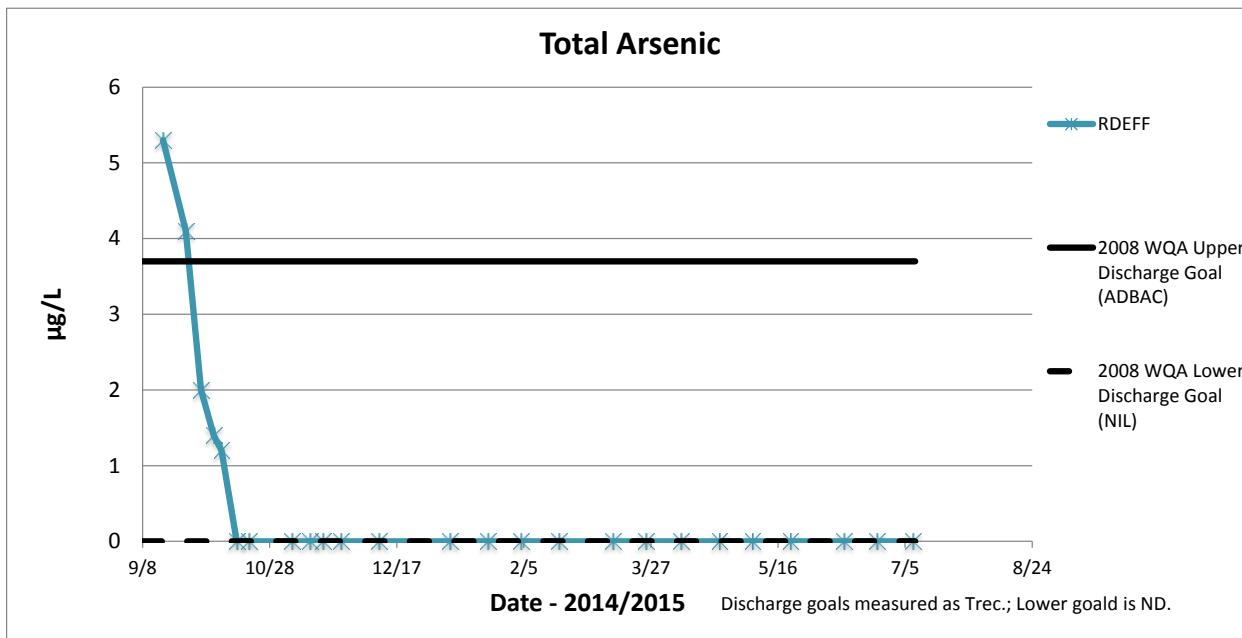


Figure C-2. HWTT Rock Drain Effluent Arsenic Data

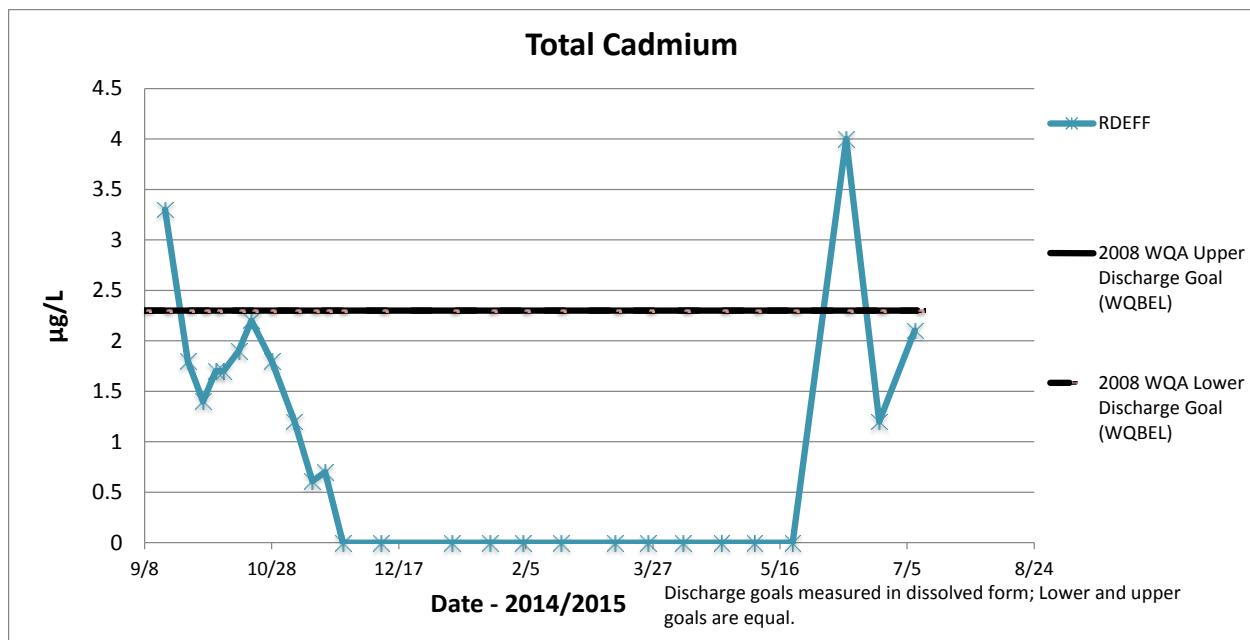


Figure C-3. HWTT Rock Drain Effluent Cadmium Data

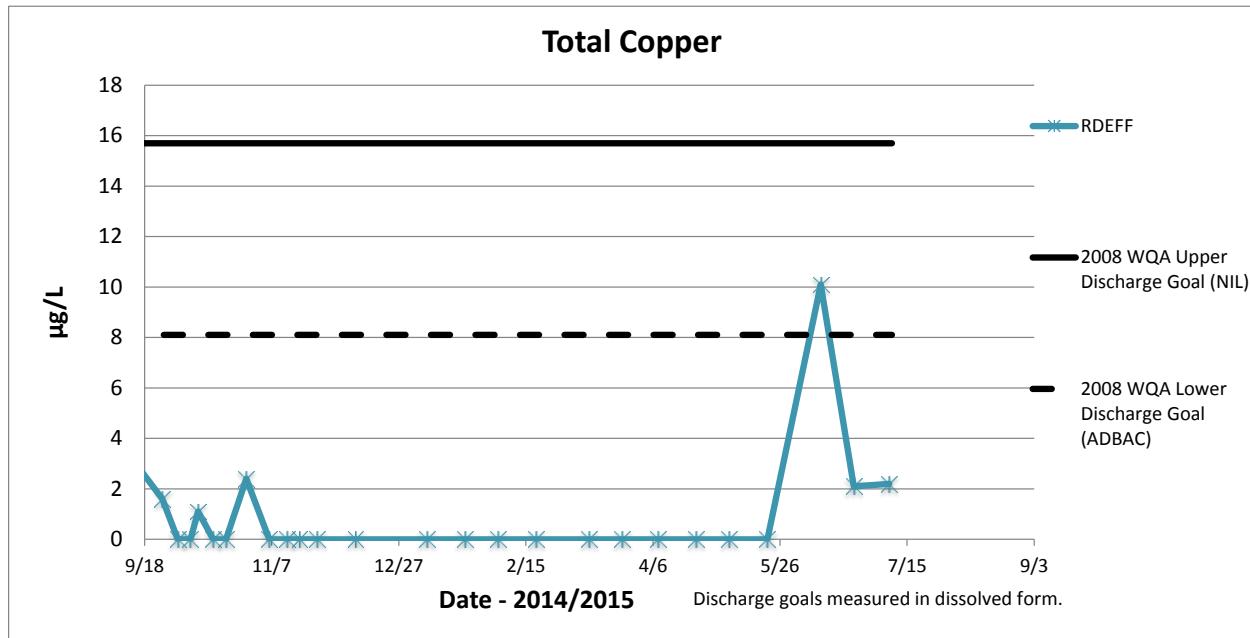


Figure C-4. HWTT Rock Drain Effluent Copper Data

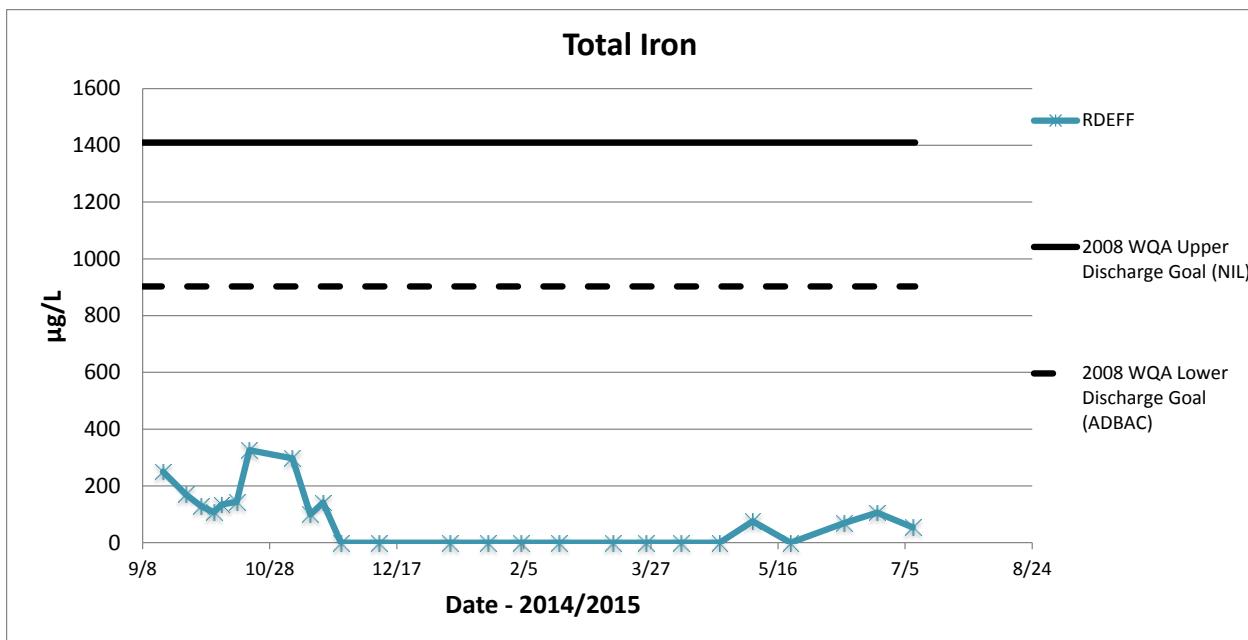


Figure C-5. HWTT Rock Drain Effluent Iron Data

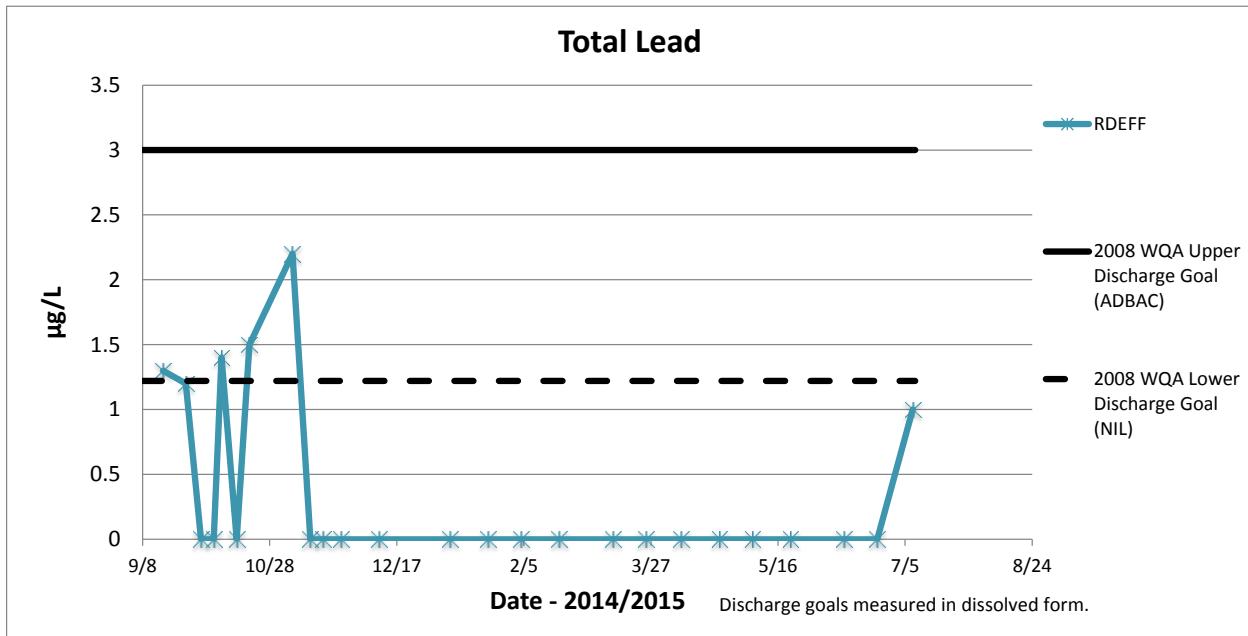


Figure C-6. HWTT Rock Drain Effluent Lead Data

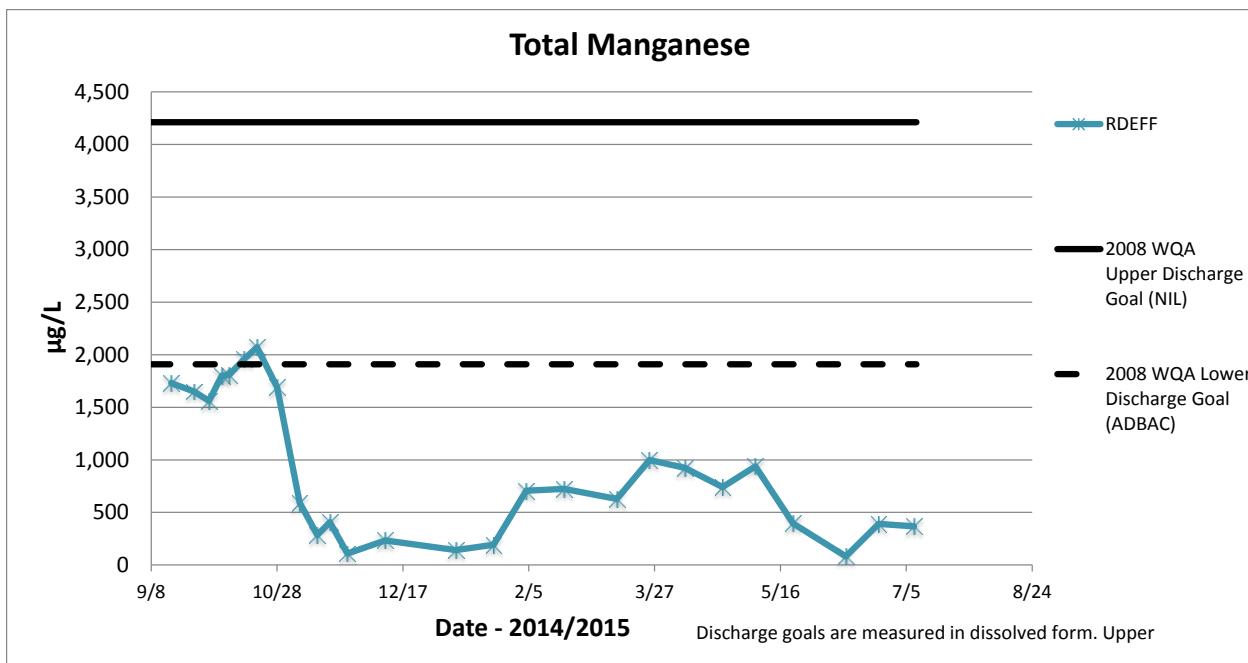


Figure C-7. HWTT Rock Drain Effluent Manganese Data

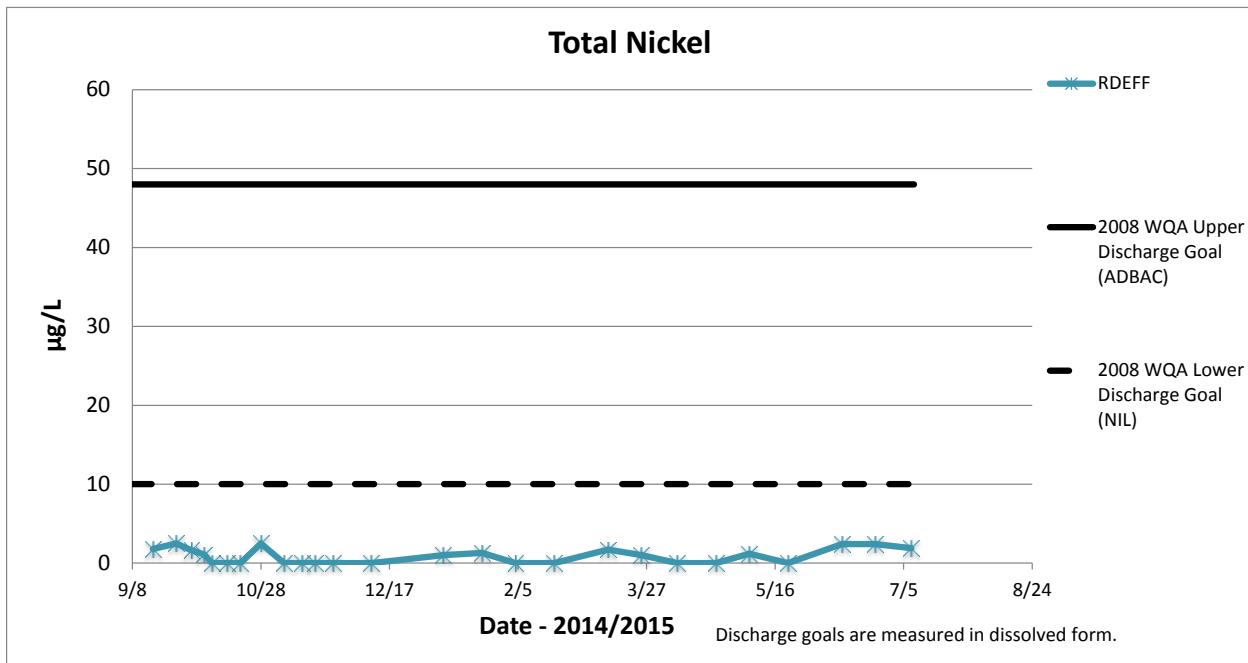


Figure C-8. HWTT Rock Drain Effluent Nickel Data

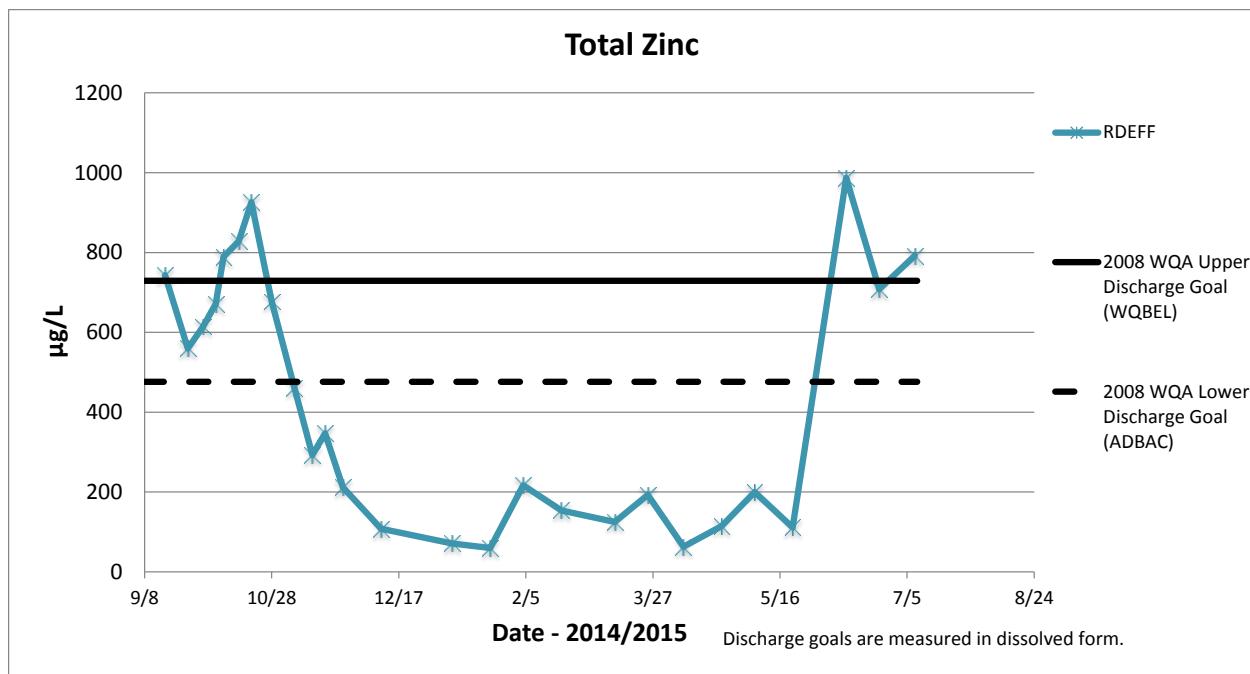


Figure C-9. HWTT Rock Drain Effluent Zinc Data